Conceptual Mitigation and Restoration Design Plan

Kerr-McGee Chemical LLC
Kress Creek/West Branch DuPage River
DuPage County, IL

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engineers, scientists, economists

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1. Introduction

1.1 Introduction

This Conceptual Mitigation and Restoration Design Plan (the Plan) presents the conceptual design for the mitigation and restoration of areas that will be disturbed by remedial activities for the Kress Creek (the "Creek")/West Branch DuPage River (the "River") Site (Kress Creek Site) and portions of the West Chicago Sewage Treatment Plant Site (STP Site), both located in DuPage County, Illinois. These two sites are collectively referred to as the "Sites" in this Plan, and are depicted on Figure 1.

The Kress Creek Site encompasses two areas – 1) approximately 1.5 miles of Kress Creek, stretching from the storm sewer outfall located south of Roosevelt Road on the east side of the Elgin-Joliet and Eastern (EJ&E) Railway to Kress Creek's confluence with the West Branch DuPage River; and 2) approximately 5.2 miles of the West Branch DuPage River, from its confluence with Kress Creek to the McDowell Dam. Land use along the Kress Creek Site includes residential areas, parks, a county forest preserve, and property owned by religious organizations and government agencies. The stretches of Kress Creek and the West Branch DuPage River within the Site flow under several bridges and traverse Manville Oaks Park, the Nichiren Shoshu Temple property, Roy C. Blackwell Forest Preserve, the Warrenville Cenacle, Warrenville Grove Forest Preserve, and McDowell Grove Forest Preserve.

The STP Site includes the West Chicago Sewage Treatment Plant, which is owned and operated by the City of West Chicago (located at Illinois Routes 59 and 38, Sarana Drive in West Chicago), and approximately 1.2 miles of the West Branch DuPage River from the northern boundary of the STP property to the confluence of the River and the Creek. Note that upland STP removal activities are being carried out pursuant to an Administrative Order on Consent (AOC); therefore that area of the STP Site is excluded from consideration in this report. Land use along the West Branch DuPage River between the northern boundary of the STP property and the confluence of the River with Kress Creek is predominantly recreational, with some residential properties located on the eastern side of the river in the northern portion of that stretch. The western bank adjacent to the STP facility is owned by the City of West Chicago. There is essentially no development from Gary's Mill Road to the confluence with the Creek, as the River flows through the Roy C. Blackwell Forest Preserve.

Except for the possible areas of the Kress Creek Site between the Warrenville Dam and the McDowell Dam that are still being investigated, Kerr-McGee Chemical LLC (Kerr-McGee) has identified the limits of sediments, banks, and floodplain areas requiring excavation at the Sites. In order for excavation equipment to access these areas and transport materials off-site, access roads, haul roads, and material staging areas must be constructed. These areas are shown on Figures 2 and 3. The locations of these support areas were selected by the Local Communities (DuPage County, DuPage County Forest Preserve, City of West Chicago, City of Warrenville, and West Chicago Park District) and Kerr-McGee to avoid and/or minimize, where possible, further disturbances to regulated wetlands, portions of the DuPage County Forest Preserve, and surrounding properties. Due to the extent of material requiring excavation and the need for access and haul roads, disturbances cannot be entirely avoided. The remediation activities will affect, to some extent, 4.7 miles of streambank, 21.8 acres of commercial/residential property (including 7.60 acres of wetlands), and 15.8 acres of DuPage County Forest Preserve property (including 5.16 acres of wetlands). A breakdown of the areas of each affected land use type is presented in Table 1. Adjustments to these totals could result from additional precautionary surface scanning that is being conducted between Warrenville Dam and McDowell Dam. Should additional areas be identified that require excavation, they will be incorporated as part of this plan and the totals will be changed accordingly.

This Plan defines the potential restoration methods that will be used to mitigate and restore, and in many cases improve, the streambanks, riparian corridor, and the terrestrial and aquatic habitats impacted by remedial activities.

Areas that will be disturbed due to implementation of remedial activities have, in some locations, been previously impacted by natural or anthropogenic activities that resulted in undesirable plant communities. It would be ecologically unfavorable to restore existing plant communities in these instances. Therefore, this restoration plan is designed to restore habitats of similar characteristics and environmental functions, but at the same time make minor modifications that either benefit the environment or meet the needs of individual landowners. The variety of restoration techniques presented in this Plan are designed to meet the wide range of physical, biological, and cultural conditions that are present within the areas of the site that are disturbed by implementation of remedial activities.

The areas that will be disturbed by remedial activities are highlighted on Figures 2 and 3. At this conceptual design stage, it is not possible to identify the exact restoration methodology that will be utilized for each disturbed area. Specific elements of the restoration design for the disturbed areas will be formulated and presented in a future detailed design document. Additional data will need to be collected to define the specific restoration technique that will be applied to each disturbed area. The restoration activities presented in this Plan provide the framework for the selection and application of the most appropriate restoration technique.

1.2 Plan Format

This introductory section (Section 1) of the Plan is followed by a general description of the physical characteristics of the Site and the general concepts associated with streambank and riparian restoration (Section 2). The next three sections present the restoration designs for disturbed areas of the Site based on three primary land uses: commercial/residential property (including the park district and city-owned property) (Section 3), wetlands (Section 4), and DuPage County Forest Preserve property (Section 5). Each section presents the specific design options for bank restoration and vegetation restoration that apply to the range of conditions within each land use. In-stream restoration activities are discussed in Section 6, and monitoring and maintenance of restored areas are discussed in Section 7. Section 8 presents the summary and conclusions. Plant nomenclature used in this Plan was obtained from Swink and Wilhelm (1994).

2. Streambank and Riparian Mitigation and Restoration – General Concepts

The present morphology of the Creek and the River is a function of water velocity, ground slope, sinuosity and bed materials. Bank restoration alternatives were developed based on velocity estimates for the Creek and the River that were developed using a hydraulic model. The periods of record for the flow information utilized in the modeling were eight years for the United States Geologic Survey (USGS) gage located in the Creek and 32 years for the USGS gage located in the River. The maximum observed storm event during these periods occurred in July 1996, resulting in flows of 1,210 cubic feet per second (cfs) for Kress Creek and 2,870 cfs for West Branch DuPage River. It was determined based on field observations that the 2-year flow approximated bankfull conditions for most locations. Several cross sections were modeled to estimate erosion potential during the 2-year (bankfull), 25-year, and maximum observed storm events. The results of the model are discussed in more detail in Appendix A of the *Conceptual Design Report* (BBL, 2002).

The discharge and velocity of the Creek and the River were modeled to evaluate water velocities at several representative cross sections during the 2-year, 25-year, and maximum observed storm events. The peak event velocity occurred for the 25-year storm event and was computed to reach a maximum of 7.5 feet per second (fps) in the Creek using the Full Equations Model (FEQ). Channel velocities for the 25-year flow in the River ranged from 1.2 to 2.5 fps (*Conceptual Design Report* [BBL, 2002], Appendix A).

The restored streambank configurations of the Site will be hydraulically simulated using DuPage County's then current FEQ model using hydrology information provided by the County. Cross sectional data utilized in the FEQ model will be collected at all locations where excavation impacts exceed 100 feet of streambank and at other select locations as required to develop the model. The restoration will be designed to result in "No Net Fill" within the floodplain in the zone between the normal water level and the 100-year flood elevation and no increase in flood profiles greater than 0.04 feet. Any increases in flood elevation encountered on a temporary basis will be contained either within existing floodplains limits, or within property that is under the control of local government or where explicit flood easements have been obtained for any event in the County's Continuous Simulation Series.

Based on the results of the model and maximum observed velocities, it is concluded that vegetated banks, once established, will provide adequate erosion protection for the majority of the disturbed bank areas (Ecosystem Management Restoration Research Program [EMRRP], 2001). As part of detailed design efforts, the hydraulic model will be applied to locations along the Creek and the River with high erosion potential to evaluate a range of erosion protection requirements under a range of flows. These evaluations and input from surrounding property owners will serve as the basis for preparation of bank restoration design specifications for all bank areas disturbed by remedial activities.

The slopes of the restored banks will be driven by post-excavation stream dimensions and surrounding land use. Conceptually, the majority of the bank areas will be restored at slopes between 3:1 and 4:1 (horizontal to vertical) for stability purposes. However, restoration of some properties may require steeper or shallower slopes. Steeper slopes may be required in residential areas where buildings, houses, yards, or roads exist in close proximity to the bank of the Creek or the River. In these areas it may be necessary to minimize the width of the bank to minimize the disruption to the surrounding property. Steep banks require additional protection from scouring and undercutting with the use of armor, bioengineered structures, or engineered structures. Scour protection for steep bank restoration can be accomplished using hard armor, such as rip-rap, cobble, or gravel material, or by bioengineered structures, such as coir logs or fiber wrapping. These bank designs can also be applied to those portions of the water bodies that may be exposed to excessive shear stresses as a result of sharp meanders. The outer edges of the meanders and the opposite bank slightly downstream that receives the rebounding secondary currents may require additional armoring if bank material is erosion prone. Less steep banks would be utilized for fringe wetland areas, where hydraulic interaction of the channel and floodplain is critical to wetland hydrology.

Multiple restoration options are presented to address the physical and biological differences encountered within each land use category, as well as specific restoration requirements of the individual landowners. The goals of the streambank restoration and mitigation activities are to restore stable banks and revegetate the riparian corridor with vegetation that is consistent with the surrounding land use. Stable stream conditions occur when the streambed is neither aggrading nor degrading and bank slopes are in a configuration that does not unduly slough and are covered with native vegetation appropriate for the environment. Bioengineering techniques will be incorporated into stable bank designs where appropriate for the expected flow frequencies and soil characteristics. Bioengineering techniques may include the use of toe stabilization to the ordinary high water mark and the use of native, deep-rooted vegetation that is suitable to the hydrologic regime and ecological landscape in which it is to be planted on the upper portions of the bank slope.

A hierarchy of preferred restoration techniques has been developed that favors the restoration of stable banks with native vegetation where appropriate, and includes the use of other bioengineered alternatives where velocities or meanders warrant additional erosion protection. The least preferred restoration alternative may consist of the use of rip-rap or other hard armoring; however, this alternative has been included because it may be specifically requested by an individual landowner. Rock used for toe protection, when appropriate and to the extent available, will consist of natural river-run variety from glacial outwash substrates indigenous to the area and will not be placed above the ordinary high water mark except in select high energy areas.

Typical cross sections of the potential bank restoration technologies that may be applied to the disturbed areas of the site are presented on Figure 4. It should be noted that the bank slopes identified on Figure 4 represent maximum slopes for the given restoration approach. Conceptually, however, the majority of the bank areas will be restored at slopes between 3:1 and 4:1.

The different bank restoration techniques apply to the range of bank restoration requirements of the various land uses and erosional forces encountered along the Creek and the River. Figures 2 and 3 also present preliminary locations where each bank restoration technique would be applied based on existing information. The specific bank restoration technique that will be applied to each section of disturbed bank will be identified in the detailed design phase of the project.

Details of the bank restoration and mitigation efforts for each of the surrounding land uses are presented in the following sections of this Plan.

3. Commercial/Residential Property Mitigation and Restoration

Approximately 21.8 acres of residential/commercial property (including 7.6 acres of wetlands) will be disturbed by removal activities at the site. This includes the park district and city-owned property as well. Note that these disturbed areas are based solely on the Conceptual Design (BBL, 2002) and will be updated and revised in preliminary and final design. Upland area mitigation and restoration is discussed in this section, while wetland area mitigation and restoration is discussed in Section 4. In general, excavated bank material will be replaced with soils similar to those removed and the banks will be graded to stable slopes and seeded or planted with native vegetation. Bank restoration techniques for commercial/residential properties will focus on the use of native vegetation to restore natural habitats, or bioengineered stabilization techniques to stabilize erosion-prone areas. Restoration on these properties will be consistent with the treatment of Forest Preserve District Property**.** However, restoration design will also consider the specific concerns of the individual property owners, which typically focus on protection of the shoreline and avoiding long-term overbank flooding. Concrete slabs have been observed on at least one property to control erosion. Therefore, commercial/residential landowners will be contacted during the detailed design phase for input on the technique for the restoration of the bank on their individual properties.

Typical cross sections of natural bank restoration techniques that are applicable to low-energy commercial/residential properties are presented as cross sections A, B, and C on Figure 4. As shown, suitably-sized rock is placed below the ordinary high-water elevation to protect the toe of the slope from erosion and to anchor a temporary erosion control blanket. The temporary erosion control blanket protects the banks and vegetation from storm-related erosive forces that might occur before the root zone is fully established. Vegetation can be seeded beneath the blanket or planted through the blanket to establish the pre-disturbance vegetative communities. Potential seed mixes of native species that are suited to revegetation of open and shaded upland banks are presented in Tables 2 and 3, respectively. Depending on the timing of the restoration effort, a non-persistent, temporary herbaceous cover crop may be planted and/or a biodegradable erosion control blanket will be installed over the bank soils to protect the bank from erosion until the desired vegetation is established. If appropriate for the land use, live stakes or shrubs can be planted through the blanket for additional bank stability and to restore bank habitat. Woody vegetation provides additional stabilization of bank material by expanding larger and deeper root systems than seeded vegetation. Plantings could consist of bare root plants, whips, or cuttings spaced at 5-ft intervals to anchor the blanket on the bank. Table 4 presents a list of native shrubs that could be planted on restored banks on commercial/residential properties, if shrub communities existed before disturbance.

High energy areas on commercial/residential properties (including the park district and city-owned property), such as outside bends of sharp meanders, may require additional erosion protection in the form of rock fortification or bioengineered structures. Should armor stone be deemed necessary, natural river-run stone, where appropriate, will be used to the extent practicable. The exact method of bank protection on each property will be discussed with each landowner. Cross sections D, E, and F on Figure 4 present typical hard armor or bioengineering techniques to protect the restored banks in high energy areas.

The restoration of vegetation in disturbed areas above the bank on commercial/residential properties will also be designed considering landowner requests. Topsoil will be replaced to original grades and grass will be seeded to restore lawns. Any removed trees and shrubs will be replaced, unless private property owners elect not to seek replacement. It is intended that landowners be given the opportunity to select non-invasive species as a replacement for any invasive species that are removed, with the final decision belonging to the landowner as to whether to seek in-kind replacement or select a different non-invasive species. For non-invasive species that are removed, the same species will be planted unless otherwise requested by the landowner. Planted shrubs will be container-grown nursery stock selected from a list of species that previously existed on the property. Planted trees will be 1.5-inch caliper root-bagged stock (2-inch equivalent) of tree species selected from a list of species that previously existed on the property. The exact location of plantings on the property will also be selected with input from the landowner. Lists of representative upland and floodplain native tree/shrub species that may be planted on commercial/residential property are presented in Tables 5, 6, and 8.

4. Wetland Mitigation and Restoration

Wetlands existing along the Creek and the River above Warrenville Dam were identified by Graef, Anhalt, Schloemer & Associates, Inc. (GAS) in 1998 and 2000 (the "Wetland Studies"). Identified wetlands were described in accordance with the Cowardin (1979) classification system. As such, large wetland systems were classified as a combination of the subsystems they contained, but the extent of each subsystem within the wetland was not delineated. Therefore, to quantify the acreage of each major wetland type, wetlands described as palustrine emergent wetlands were considered emergent wetlands, wetlands described as scrub-shrub or combinations of scrub-shrub and emergent wetlands were considered scrub-shrub wetlands, and wetlands identified as forested wetlands or forested wetlands with emergent and/or scrub-shrub wetlands were considered forested wetlands. Wetlands in the McDowell Grove Forest Preserve were identified by a combination of review of National Wetland Inventory maps and Site reconnaissance. These wetlands were identified as forested wetlands.

Based on this methodology, Table 1 presents a breakdown of the area of each wetland type that will be disturbed by remedial activities. As shown, a total of 12.76 acres of wetlands, consisting of 3.03 acres of emergent, 0.19 acres of scrub-shrub, and 9.54 acres of forested wetlands will be disturbed either by the removal of soil and vegetation in the material removal areas, or by vegetation removal and soil compaction beneath access roads and haul roads. Note that these disturbed areas are based solely on the Conceptual Design (BBL, 2002) and will be updated and revised in preliminary and final design. The locations and types of wetlands within the project area are presented on Figures 5 and 6.

Figure 5 also identifies the location of some fen wetlands that the Local Communities have identified as critical wetland areas which should be preserved and protected throughout the remediation/restoration process, if possible. As shown on Figure 5, fen wetlands have currently been identified near the River (on either side of the drainage from McKee Marsh near the intersection of Route 59 and Mack Road). To protect this fen wetland during remediation/restoration associated with the adjacent excavation areas, a temporary chain-link fence will be installed to separate the fen wetlands from the active work area, thereby minimizing the opportunity for inadvertent damage from equipment and/or restoration activities. Upon completion of the restoration activities, the fence will be removed without further disturbance to the fen area.

Those wetlands that are temporarily disturbed by construction access, haul routes and/or staging or lay down areas will be restored and the lost functions of the wetland community will be mitigated by the restoration or creation of 0.5 acres of wetlands for each impacted wetland acre. Excavated wetlands shall be considered permanently impacted and mitigated by wetland creation and/or restoration at a ratio of 1.5 to 1. In any event, the combination of restored wetland acreage and new wetlands meeting all performance criteria shall equal or exceed a ratio of 1.5 to 1. This mitigation ratio is considered appropriate since the wetland studies performed to date have not identified any “high quality” wetlands in the areas subject to remediation. The wetland mitigation sites for wetlands on the Forest Preserve will be selected by the Forest Preserve District. If the Forest Preserve District is unable to locate sites on district property of sufficient size or with suitable characteristics, a plan for mitigation efforts at an alternate site will be proposed.

Disturbances to isolated fen communities that occur along and within the planned excavation areas will be avoided to the maximum extent practical. Where fen communities require remediation, the impact will be mitigated by creating three acres of wetland for every one acre of fen area disturbed, following the same general requirements as outlined above for wetland mitigation. Enhancements to existing wetlands by modifying ground elevation, hydrology, or vegetation may also be used to contribute to mitigation requirements at a rate of 0.25 acres of wetland credit per acre of wetland enhanced (only for acreage not otherwise disturbed by excavation). The fen area located at the confluence of the West Branch of the DuPage River and an unnamed tributary from the McKee Marsh (as shown on Figure 5) will be fenced off adjacent to the work area to minimize the potential for accidental disturbance to this community.

The preferred method to mitigate wetland impacts resulting from remedial activities on the site will be restoration of former wetlands (i.e., bringing back conditions that previously supported a wetland). The ability to utilize restoration of former wetland areas as mitigation for wetland disturbances is a function of the quantity of restorable former wetlands in the watershed. Restoration of these areas will be prioritized to achieve wetland mitigation requirements. Remaining wetland mitigation requirements would be met either through the enhancement of existing wetlands or the creation of new wetlands within the watershed. The dependable hydrologic source provided by the site surface waters will facilitate the creation of fringe wetlands and increases their likelihood for permanent sustainability.

Disturbed wetlands will be restored in soil removal areas by restoring original grades and planting native wetland vegetation that is appropriate for the type of wetland being restored. It is anticipated that additional wetland areas will be restored, enhanced, or created in adjacent or nearby areas to meet the mitigation requirements for the disturbed areas. Wetland mitigation will occur in locations that are environmentally suited to wetland creation in order to maximize the ability of the wetland to provide ecological functions to the Creek or the River. These areas may be adjacent to restored wetlands, adjacent to the Creek or the River, or adjacent to tributaries to the Creek or the River. If appropriate, staging areas and/or temporary roads may be restored as wetlands on Forest Preserve property to minimize new disturbances to forest land. Insufficient data are currently available to identify precise types and locations for mitigation wetlands, but additional information will be collected under the detailed design phase of the project to further develop the wetland mitigation plan.

Removed material in identified wetlands will be replaced to existing grades with a combination of subgrade backfill and wetland supportive (hydric) soil. It is anticipated that existing wetland overburden soils will be used for the hydric soil backfill to the greatest extent possible. Where additional off-site soils are required, backfill sources will be identified to provide similar soil types to match the existing soils. The depth of hydric soils will vary depending on the type of wetland and the vegetation types; however, a minimum of 6 inches is anticipated. Specifications for the wetland hydric soil will be prepared based on laboratory characterization of existing wetland soils performed during detailed design efforts. Wetland soils beneath roads and staging areas will be physically uncompacted (disced, tilled, or similar) if needed and restored to original grades following removal of road and staging area materials. Depending on the amount of soil compaction and the amount of original soil removed with the road/staging area construction materials, additional hydric soil may need to be imported to restore original grades.

Banks associated with fringe wetlands will require different bank restoration approaches than upland areas. In wetland areas, the primary concern is the interaction of the channel water with the floodplain. The primary difference in bank construction in wetland areas compared to upland areas is a major reduction in bank slope to restore hydrologic conditions that support and maintain the wetland systems. Bank slopes would be designed on a site-specific basis, based on the elevation of the surrounding wetlands they connect to the channel.

Vegetation restoration in wetland areas is driven by the type of wetland disturbed, with disturbed emergent, scrub-shrub, and forested wetlands planted with native species at densities designed to restore the original habitat type. The planting plan for restored wetlands is summarized on Figures 5 and 6. A general discussion of the existing wetlands that will be disturbed and the mitigation and restoration concepts for the different wetland types are provided in the following sections.

4.1 Emergent Wetlands

Based on the results of the Wetland Studies (GAS, 1998 and 2000), approximately 3.03 acres of emergent wetlands will be disturbed along the Creek and the River. These emergent wetlands are also intermixed with scrub-shrub and forested wetland areas. The emergent wetlands of the Sites are dominated by a variety of grasses, sedges, rushes, and forbs, including *Phalus arundinacea* (reed canary grass), *Glyceria striata* (fowl mannagrass), *Carex* spp., *Scirpus atrovirens* (dark green bulrush), *Impatiens capensis* (spotted jewelweed), and *Verbena hastata* (blue vervain) (GAS, 1998 and 2000). Although the existing species composition of emergent wetlands was utilized to formulate a seed mix for emergent wetland restoration, non-desirable species were eliminated from the mix and additional native species were added. Tables 2, 3, and 7 present lists of native plant species that will be seeded and/or planted in the restored emergent wetlands as well as the respective seed application rates and planting densities. If areas to be restored as emergent wetlands are inundated at the time of planting, individual plants may be planted instead of seeds to establish the emergent plant community. The density of emergent vegetation plantings is presented on Table 7. Figure 7 provides conceptual plan and profile views of the restored emergent wetland. New plantings will be protected from bird and mammal herbivory as required based on conditions encountered; protections could include such items as netting, fencing, tree guards, or deterrent sprays. The monitoring activities identified in Section 7 of this Plan will be used to determine whether protection is required.

As previously discussed, emergent wetlands that exist as fringes along the Creek or the River channel require different bank restoration techniques from upland areas. Typical cross sections of bank restoration in an emergent fringe wetland area are presented as cross sections C and G on Figure 4. As shown, banks are restored to original grades with backfill and topped with a layer of hydric soil. Emergent wetland vegetation is seeded beneath and/or planted through an erosion control blanket, which protects the soil and vegetation from storm-related erosional flows that might occur before the bank-anchoring root zone is adequately established.

4.2 Scrub-Shrub Wetlands

Based on the results of the Wetland Studies (GAS, 1998 and 2000), approximately 0.19 acres of scrub-shrub wetlands will be disturbed along the Creek and the River. These scrub-shrub wetlands areas are also intermixed with emergent and forested wetland areas. The scrub-shrub wetland areas of the Sites are dominated by shrub species such as *Rhamnus cathartica* (European buckthorn), *Acer negundo* (box elder), *Lonicera maacki* (honeysuckle), *Ribes americanum* (wild black current), and *Cornus foemina* (swamp dogwood) (GAS, 1998 and 2000)). As with the emergent wetlands, the existing species composition in scrub-shrub wetlands was utilized to formulate a planting plan for scrub-shrub wetland restoration, but non-desirable species were eliminated and additional native species were added. Emergent wetland vegetation would be seeded in scrub-shrub wetlands with the native species presented in Tables 2 and 3, but at half the indicated seed application rates since they will only be used to establish ground cover. If areas to be seeded are inundated at the time of seeding, individual plants may be planted instead of seeds to establish the emergent plant community. Planted shrubs will be in the form of bare root plants, cuttings, and/or container stock. The potential shrub species are listed in Table 8, and planting densities are presented on Figures 5 and 6. Shrubs will be planted in clusters of the same species to establish micro-communities in the wetland**.** Figure 8 provides conceptual plan and profile views of the restored scrub-shrub wetland. New plantings will be protected from bird and mammal herbivory as required based on conditions encountered; protections could include such items as netting, fencing, tree guards, or deterrent sprays. The monitoring activities identified in Section 7 of this Plan will be used to determine whether protection is required.

As previously discussed, fringe wetlands require bank restoration techniques that address stability as well as hydraulic interaction with the channel. The banks of fringe scrub-shrub wetlands will be restored similar to the emergent wetlands, but with the addition of shrub plantings through the erosion control blanket. Typical cross sections of the bank restoration techniques that are applicable to fringe scrub-shrub wetlands are presented as cross sections B, C, and G on Figure 4. As shown, banks are restored to original grades with backfill and topped with a layer of hydric soil. Shrubs are planted through the erosion control blanket which anchors the blanket on the slope to protect the soil and vegetation from storm-related erosional flows that might occur before the root zone is adequately established.

4.3 Forested Wetlands

Based on the results of the Wetland Studies (GAS, 1998 and 2000), approximately 9.54 acres of forested wetlands along the Creek and the River will be disturbed by remedial activities at the Sites. These forested wetlands contain areas of emergent and scrub-shrub wetlands. The forested wetlands of the Sites are dominated by *Populus deltoides* (Eastern cottonwood), *Acer saccharinum* (silver maple), box elder, *Fraxinus pennsylvanica* (green ash), buckthorn (reported as *Crataegus* spp. [hawthorns] by Weston, 2000), *Ulmus americana* (American elm), *Salix alba* (white willow), and *Salix nigra* (black willow) (GAS, 1998 and 2000).

The existing tree species in forested wetlands were utilized to formulate a planting plan for forested wetland restoration but non-desirable species were eliminated and native species were added. Planted trees will be in the form of 1.5-inch caliper root-bagged tree stock (equivalent to 2-inch diameter at breast height [DBH]) planted at an average density of 100 trees per acre in clusters of the same species. Table 6 presents a list of potential native tree species to be planted, and planting densities are summarized on Figures 5 and 6.

Herbaceous wetland vegetation would be seeded in forested wetlands with the species presented in Tables 2 and 3, but at half the indicated seed application rates since they will only be used to establish ground cover. If areas to be seeded are inundated at the time of seeding, individual plants may be planted to establish the herbaceous plant community. Shrubs will be planted in the form of bare root plants, cuttings, and/or container stock. The potential shrub species are listed in Table 8, and planting densities are presented on Figures 5 and 6. Shrubs will be planted in clusters of the same species to establish micro-communities in the wetland.

Figure 9 provides conceptual plan and profile views of the restored forested wetland. New plantings will be protected from herbivory by small and large mammals as required based on conditions encountered; protections could include such items as netting, fencing, tree guards, or deterrent sprays. The monitoring activities identified in Section 7 of this Plan will be used to determine whether protection is required.

As previously discussed, fringe wetlands require bank restoration techniques that address stability as well as hydraulic interaction with the channel. The banks of fringe forested wetlands will be restored with the same methods utilized for scrub-shrub wetlands, as shown on cross sections B, C, and G on Figure 4. Forested wetland banks are restored to original grades with backfill and topped with a layer of hydric soil. Shrubs are planted through the erosion control blanket, which protects the soil and vegetation from storm-related erosional flows that might occur before the bank-anchoring root zone is adequately established.

5. DuPage County Forest Preserve Property Mitigation and Restoration

The area of Forest Preserve property that will be disturbed by remedial activities at the Sites is approximately 15.8 acres. Approximately 10.6 acres of this area is upland forest and 5.2 acres is forested wetlands. Note that these impacted areas are based solely on the Conceptual Design (BBL, 2002) and will be updated and revised in preliminary and final design. A primary objective of mitigation and restoration activities on Forest Preserve property is to maintain the natural character of the banks and restored habitats. The portions of the Forest Preserve property that are wetlands will be restored in accordance with the designs presented in Section 4 of this Plan. This section presents the restoration plan for the upland forest portions of the Forest Preserve property that will be disturbed by remedial activities. The restoration design restores the forested habitat by replacing topsoil and planting native tree species at densities that are typical of a forested habitat.

The forested upland portions of the Forest Preserve property that will be disturbed were reported by GAS (1998, 2000) and Weston (2000) to be dominated by box elder, American elm, *Quercus macrocarpa* (bur oak), green ash, *Tilia americana* (basswood), *Prunus serotina* (black cherry), cottonwood, *Juglans nigra* (black walnut), and *Morus alba* (white mulberry). The existing tree species in forested areas were utilized to formulate a planting plan for forest restoration by eliminating non-desirable species and adding species to increase the plant diversity and ecological value of the restored land. The existing forested uplands support a mature canopy that limits the amount of sunlight that reaches the forest floor and, therefore, limits the development of ground cover. However, ground cover will need to be initially established as part of restoration efforts for erosion control until the tree community matures.

Forested areas will be restored to original grades with backfill and topsoil, and planted with herbaceous vegetation and trees to restore the forested upland community. Ground cover will initially be established from seed for erosion protection and to restore the herbaceous species of a typical more open forest. Depending on the timing of the restoration effort, a non-persistent and non-allelopathic temporary herbaceous cover crop may be planted and/or a biodegradable erosion control blanket will be installed until the desired vegetation is established. If the desired long-term vegetation is not planted with the temporary crop, it will be planted in the first available growing season appropriate for that species. Herbaceous vegetation would be seeded in restored forestlands in accordance with the species and seed application rates presented in Table 9. Shrubs will be planted in the form of bare root plants, cuttings, and/or container stock. The potential shrubs are listed in Table

8. Shrubs will be planted in clusters of the same species to establish micro-communities**.** Root-bagged tree stock of 1.5-inch caliper trees (equivalent to 2-inch DBH trees) would be planted at a density of 100 trees per acre in groups of the same species. Tree species potentially appropriate for planting on the Forest Preserve are listed in Table 5. New plantings may require protection from herbivory by small and large mammals based on conditions encountered; protections could include such items as netting, fencing, tree guards, or deterrent sprays. The monitoring activities identified in Section 7 of this Plan will be used to determine whether protection is required. Figure 10 provides conceptual plan and profile views of the restored upland forest.

Banks that are disturbed in upland forest communities of the Forest Preserve along the River channel will be restored to stable slopes with backfill and topsoil, and seeded and planted to match the surrounding habitats. As previously mentioned, a primary objective for mitigation and restoration activities in the Forest Preserve is to maintain the natural appearance of restored banks. Stable banks exposed to low-energy flows in forested areas will be restored with natural materials to blend in with the surrounding land use, as presented in cross sections A, B, and C on Figure 4. Forested banks will be restored to original grades with backfill and covered with a layer of topsoil. Herbaceous vegetation and shrubs are seeded beneath or planted through an erosion control blanket, which protects the topsoil and vegetation from storm-related erosional flows that might occur before the bank-anchoring root zone is adequately established. Depending on the timing of the restoration effort, a non-persistent and non-allelopathic temporary herbaceous cover crop may be planted to stabilize the banks until desired vegetation becomes established. If the desired long-term vegetation is not planted with the temporary crop, it will be planted in the first available growing season appropriate for that species. In addition, a biodegradable erosion control blanket, matting, or netting of organic fiber matrix (i.e., equal to or better than North American Green SC150BN) will be installed on the bank from the ordinary water level to the normal high water level to stabilize soils on slopes steeper than 6:1 until the desired vegetation is established**.** Tables 2, 3, 4, and 8 present the species, types, and densities of plants that will be used in the restored banks of uplands in the Forest Preserve. In addition, tree species listed in Tables 5 and 6 may also be planted in smaller sizes (gallon containers), where appropriate based on previous vegetation and bank width.

Restored banks in forested uplands in the Forest Preserve that may be exposed to high energy flows as a result of sharp meanders or other physical condition may require additional protection from erosion than that provided by the vegetated banks. To maintain the natural character of the bank in high-energy bank areas, bioengineered streambanks that utilize soil aggregate armoring or planted fabric wraps, as presented on cross sections E and F, respectively, on Figure 4, will be applied to high energy areas in the Forest Preserve. Should armor stone be deemed necessary, natural river-run stone, where appropriate, will be used to the extent practicable. Seeding and planting in the bioengineered banks will utilize the same species, plant types, and densities described above for the low energy banks in the Forest Preserve.

5.1 Potential Mitigation and Enhancements on Forest Preserve Property

The Forest Preserve representatives and Kerr-McGee have agreed (September 25, 2002 letter agreement from Sam Vinson, representing Kerr-McGee to Joe Karaganis, representing the Forest Preserve) that it will be appropriate to conduct certain types of enhancements to mitigate effects of the contemplated remediation activities. Specific mitigation projects will be determined through discussions between representatives of the Forest Preserve and Kerr-McGee. Such enhancements may be carried out in areas to be restored because of direct effects of remediation or in areas of the Forest Preserve that will not be disturbed by the remediation. Specifically, the September 25, 2002 agreement documents that the "agreed financial value" of the measures that Kerr-McGee commits to undertake is approximately $600,000. This financial metric was developed in the spirit of Forest Preserve regulations and reflects potential value of the replacement costs of trees of diameters sufficient to substitute for desirable species of trees that will be removed in the conduct of the remedy.

The specifics of the agreement are that Kerr-McGee will replace any trees damaged or removed as a result of or in relation to the Work as provided in the Final Design/Remedial Action Work Plan(s) with the following limitation. The District and Kerr-McGee have agreed that the density of trees currently present in the Kress Creek Site may not be optimum from an ecological standpoint. Therefore, those parties have agreed that Kerr-McGee's obligation to replant trees will be limited to partial replacement supplemented by additional work as directed by the District and/or cash payment so that the combination of the value of the additional work and cash payment is equivalent to the value of the trees disturbed, but not replaced. That payment will be calculated as follows:

(a) Based on physical tree counts and measurement of trees within the plots, a projected average total inch diameter was prepared. Individual trees over 12 inches in diameter were taken from the tree survey prepared by Weston (2000). On the average, the District and Kerr-McGee anticipate that the trees to be removed total 1,130 inch-diameter (breast height) per acre of disturbed property on District land. Further, the Conceptual Restoration and Mitigation Plan calls for replanting 100 root bag trees per acre, which the District and Kerr-McGee have agreed would be equivalent to 100 2 inch-diameter trees. Therefore, this Plan generally calls for 200 inch-diameter to be replaced per acre. The net lost inch-diameter per acre of disturbed area is therefore 1,130 minus 200 or 930 inch-diameter per acre.

(b) The District and Kerr-McGee further agreed that each root bag tree would be assumed to have a value of $100 in replacement cost. Therefore, the cost was calculated based on 465 root bag trees per acre as replacement with a dollar value of $100 per tree, or $46,500 per acre. The total limit of disturbance would be based on the Final Design/Remedial Action Work Plan(s) and that the total figure may change based on the final acreage disturbed. This cost per acre will be used in calculating the extent of Kerr-McGee's obligation to perform additional work as the District may direct on District property beyond the scope of the planned work.

(c) Moreover, the parties have agreed that the dollar value of additional work will be "costed" on the basis of the estimated, avoided costs of such projects to the Forest Preserve, assuming it would otherwise have to contract with a third party for the conduct of the work. This "cost" is in contrast to the actual costs that may be incurred by Kerr-McGee and its contractors, taking account of economies of scale that result from the substantial deployment for remedial purposes at this site.

Additionally, Kerr-McGee has agreed with the Department of the Interior (DOI) (as outlined in an Agreement in Principle relating to the Kerr-McGee West Chicago NPL Sites dated October 10, 2003) to implement certain streambank and in-stream restoration funding in the form of a payment to DOI of $200,000 exclusively to fund activities that promote mitigation, restoration, and/or enhancement of those areas of the streambank or in-stream environment of the West Branch DuPage River or Kress Creek that are outside the footprint of the remedial activity undertaken at the Sites. DOI, in consultation with the State of Illinois and the DuPage County Forest Preserve, will have exclusive authority over the nature of the projects that will be undertaken.

Opportunities for environmental enhancements exist in the River on Forest Preserve property, at bank locations that are currently eroding, in degraded wetland areas, and in degraded riparian habitats. Enhancement options within each of these categories are briefly described in the following subsections.

5.1.1 In-Stream Habitat Enhancements

As discussed in Section 6, in-stream structures and habitat complexes that are disturbed by the remediation work will be restored under this Plan. However, the River provides a number of recreational opportunities for the public, including boating, fishing, and opportunities to observe wildlife. In addition to the Section 6 mitigation and restoration work, the quality of fish habitat in the River could be enhanced through several activities. Habitat structures could be installed in the River to provide cover, feeding, or spawning habitats for a variety of resident fish species. Habitat structures could include riffle/pool complexes, boulder clusters, gravel substrate, lunker boxes (artificial undercut banks), logs, rock bars, or scour pools. In addition, structures could be installed that vary or redirect flow to protect erosion prone areas or provide variability in water velocities, to provide feeding and cover opportunities for fish.

In addition to the installation of structures, River habitat quality could be enhanced by the removal of “clean” fine sediments (as part of the remediation efforts) that may have accumulated in depositional areas of the River. Fine sediments provide poor habitat for invertebrate communities, which provide a significant component of the forage base of River fish. In addition, these fine sediments are poor habitat for fish spawning, may exhibit reduced oxygen levels, and can be transported downstream during storm events. Removal of this material would result in water depth variability, improved substrate conditions, and protection of downstream areas from redeposition of the fine sediment.

5.1.2 Stabilization of Erosion-Prone River Banks

As previously discussed, disturbed banks in the Forest Preserve will be stabilized using bioengineering techniques that blend into the surrounding land use. These bioengineered bank stabilization techniques could also be applied to erosion prone banks of the River that will not be disturbed by remedial activities. Stabilization of eroding banks can 1) reduce sediment loads in the River, which can improve water quality and fisheries, 2) reduce sediment accumulation in the River, which can cover higher quality substrates and create shallow water areas that can affect water temperatures, and 3) protect shoreline habitats from erosion-related losses.

5.1.3 Enhancement of Degraded Wetland Areas

Wetlands that have degraded as a result of invasion of non-native species, or have lost pre-colonial characteristics of diversities in water depths, exist within the Forest Preserve. These wetlands can be enhanced by the removal of undesirable vegetation and the reestablishment of native wetland plant communities by seeding and/or planting, as discussed in Section 3 of this Plan. Diversity of water depths in riparian wetlands can be accomplished by excavating soils to create pockets of deeper water in emergent and scrub-shrub wetlands that provide habitat for a variety of avian, amphibian, and reptilian wildlife; increase flood storage capacity; and provide water quality maintenance functions to the River.

5.1.4 Enhancement of Degraded Riparian Habitats

Much of the riparian corridor along the River in the Forest Preserve has been invaded by non-native species, which are competing with native trees and may eventually dominate the forest systems. Buckthorn and box elder dominate the forest understory to such a density that native tree seedlings cannot compete. This degraded forest condition can be enhanced by removing undesirable tree species. The forests can be further enhanced by seeding and/or planting native species to: 1) support the return of native species to the forest community; 2) establish ground cover that can control invasion by non-native herbs, such as garlic mustard, while the forest canopy develops; and 3) establish conditions for the long-term sustainability of the native forest community.

6. Aquatic Habitat Mitigation and Restoration

Approximately 9 acres of the Creek and the River will require the removal of channel sediments. The removal of channel sediments and use of the dewatered channel to access removal areas can disturb in-stream structures or riffle/pool complexes that provide habitat for a number of fish species that inhabit the Creek and the River. Therefore, this Plan includes the mitigation and restoration of disturbed in-stream structures or habitat complexes to maintain and, when feasible, improve the quantity and diversity of habitats that currently exist.

Restoration of in-stream structure and habitat complexes will be accomplished by documenting the presence and location of these structures in the channel before and after dewatering activities required for material removal. The type, size, and location of significant habitat structures will be photo-documented and recorded in field notes prior to any in-stream construction activities. During low flow/high visibility conditions in the stream reaches prior to dewatering or immediately following dewatering, mussels that are visible on the substrate in each reach will be collected and relocated to the immediately upstream reach considered to be functionally restored to a level sufficient to support reproduction of these organisms. This relocation will be performed to the maximum extent practicable.

If necessary, significant structures, such as large boulders, boulder clusters, or gravel/rock substrates will be temporarily removed from the channel for replacement into the channel following sediment removal activities. In addition, sudden changes in channel elevation that support riffle/pool complexes or plunge pools will be restored to their approximate pre-disturbance sizes and elevations following sediment removal activities. Additional appropriate size rock may be required to return the habitat structures to their previous functions in the channel. Where appropriate, rock used in Site haul roads, if suitably sized, may be used to enhance or restore upstream structures and/or create riffle complexes. Large woody debris that is removed from the channel will be replaced.

This plan is not intended to prohibit including additional in-stream habitat enhancements, such as leaving a riffled streambed after remediation, that do not increase the cost of the remedy or the mitigation/restoration activities.

Where existing conditions allow, riffle runs will be created by the incorporation of either existing or imported appropriately sized rock. In general, in order to maintain a natural appearance to the stream, river-rounded rock sources, indigenous to the area, will be required to the extent that such rock is available. Enhancements could also include the creation of backwater eddies by the utilization of flow deflection devices and systems including, but not limited to, bendway weirs and select log placement structures.

In areas of significant sediment removal from the streambed, restoration of pool and riffle complexes shall be considered as a priority in the streambed restoration. The design of pool and riffle complexes will be generally consistent with the principles presented in Newbury and Gaboury (1993).

To restore habitat quality that existed prior to sediment deposition, the sediments that will be removed from the zone of influence behind a dam will not be replaced in the streambed. If appropriate, these areas above dams will be considered for the construction of riffle pool complexes and riffle runs. With approval, removed clean overburden may be utilized in other site restoration efforts, where the material is appropriate, such as the construction of in-stream habitat structures, grading of excavated banks, or in restored or created wetlands. Excess overburden sediments will be placed at appropriate locations, designated by the Forest Preserve District, on Forest Preserve property that will be cleared, graded, seeded and otherwise restored and monitored in a manner consistent with the final design and approved by the Forest Preserve District.

In utilizing the streambed as a haul route, a certain amount of the existing rock will have to be moved in order to accommodate the movement of construction vehicles, and additional stone may be added purely for the purpose of maintaining a suitable haul route. Added stone will be removed at the end of the construction period for that reach unless leaving it in place will improve the habitat quality and stream function of the streambed compared to its condition prior to utilization as a haul road. Naturally-occurring large-sized stones and boulders that were set aside during the haul route preparation will either be replaced with glacial outwash substrate or put back in place.

7. Maintenance and Monitoring of Restored Areas

Restoration activities on residential/commercial, wetland, and Forest Preserve properties will be monitored and maintained to document the progress of the areas towards the restoration goals. Monitoring of the restored upland areas will be performed for a minimum of three years (with the exception of residential/commercial uplands where monitoring will be performed for one year) to evaluate the health and progress of seeded and planted vegetation and respond to maintenance needs. The 3-year period will start upon completion of restoration, including initial planting and seeding. The success of the seeded and planted vegetation will be quantitatively measured based on the survival of planted species, the percent herbaceous cover, and presence of invasive species. Invasive species include, but are not limited to: *Typha spp.* (cattail), *Phragmites australis* (common reed), *Poa compressa* (annual blue grass), *Poa pratensis* (Kentucky blue grass), *Lythrum salicaria*, (purple loosestrife) *Salix interior* (sandbar willow), *Echinochloa crusgalli* (barnyard grass), *Rhamnus cathartica* (common buckthorn), *Rhamnus frangula* (glossy buckthorn), *Lonicera spp.* (honeysuckle), and *Phalaris arundinacea* (reed canary grass).

The quantitative monitoring data to be collected will include measurements in randomly located plots throughout the restored areas including: 1) shrub survival in 25- square meter plots (3 per acre); 2) tree survival in 100-square meter plots (1 per acre), 3) herbaceous cover in random 1-square meter plots (10 per acre); and 4) presence of invasive species in the same shrub, tree, and herbaceous cover measurement plots.

Maintenance activities will be implemented based upon the following performance standards:

- replacement of dead trees or shrubs to maintain a ninety percent (90%) survival rate of the woody plants;
- re-seed or replant to maintain an eighty-five percent (85%) herbaceous cover in seeded or planted areas; or
- control of invasive species to be less than five percent (5%) (15% in stream corridors) based on the total planted restoration area.

If it is determined at the end of the three-year monitoring period (or one-year monitoring period for residential/commercial areas) that the foregoing performance standards have not been achieved for all areas, then adaptive management activities will be implemented for the deficient areas and monitoring of the deficient areas will be extended until the performance standards have been achieved.

Monitoring of restored bank areas will be performed for a minimum of three years to evaluate the health and progress of seeded and planted vegetation and respond to maintenance needs. Restored bank areas will be monitored in the same manner using the same performance standards used for the upland areas above, except that the performance standard for invasive species will be changed to less than fifteen percent (15%). In addition, monitoring of restored bank areas for signs of erosion or bank failure will be performed for three years following completion of restoration activities. Monitoring will be performed following flood events that equal or exceed the bankfull (approximately a 2-year recurrence frequency) flood event. If at the end of the three year monitoring period, a bankfull event has not occurred, monitoring of erosion prone banks shall continue until a bankfull flow event has occurred. Maintenance will be performed in areas of significant erosion, as required to stabilize the area. If it is determined at the end of the three-year monitoring period that the foregoing criteria have not been achieved for all areas, then adaptive management/maintenance activities will be implemented for the deficient areas and monitoring of the deficient areas will be extended until the criteria have been achieved.

Restored wetlands and mitigation wetland areas will be monitored in the same manner using the same performance criteria used for the upland areas above (the, 85% herbaceous cover criterion will apply to aquatic planting areas), except that annual reports will be submitted to the state and federal wetland regulators. These annual reports will document the progress of the restored wetlands towards performance criteria, describe any maintenance activities that were required to adaptively manage the wetland, and provide photo-documentation of vegetation development from permanent photo points. If wetland performance criteria are met at the end of three years and the wetland has proved to be self-sustaining, the wetland would be accepted as a successful restoration. If wetlands are not meeting performance criteria within three years for all areas, adaptive management would be incorporated into design revisions that re-direct wetland progress towards success until the performance criteria are met for the deficient areas.

In addition, for restored upland, bank and wetland areas located within recreational properties (i.e., publicly-owned properties) the following metrics will also be used during the monitoring period as a means to evaluate the relative progress of the restored vegetative communities and the success of these communities in achievement of the intent of the restoration design:

- Within the restored upland and bank areas of the Forest Preserve, at the end of the first three growing-season months, following installation of desired long-term vegetation or, where necessary, temporary herbaceous cover crops, at least 90% of exposed areas will be vegetated.

- The relative importance value of total native plants (RIV_n) shall increase from the end of the first full growing season to the end of the third full growing season after planting. The RIV_n is calculated by first calculating relative frequency (RF_s) and relative coverage (RC_s) of each species in each quadrant. RF is the measure of the level of occurrence of a single species in a given plant community. RC is the percentage of area occupied by a single species in a given plant community where the sum of the species' cover in that community equals 100%. The relative importance value (RIV_s) of each native species is then calculated by the equation:

$$\frac{RF_s + RC_s}{2 \times 100} = RIV_s.$$

- By the end of the third year after planting, a native mean Coefficient of Conservatism value or C (native mean C value) of greater than or equal to 3.5 shall be achieved, measured over the entire restoration area. The C value is the measure of native plant community quality established by Swink and Wilhelm (1994). A Floristic Quality Index (FQI), which is a plant community measure of the C value, will also be calculated by multiplying the C value by the square root of the number of native species. The C value and FQI must increase from the first to the third year after planting.

- If the native mean C value, native FQI and/or RIV_n have not increased from the first to the third growing season, appropriate corrective actions will be taken to achieve the restoration intent of the design.

- By the end of the third full year after planting, none of the three most dominant plant species in the restoration areas may be non-native species or weedy species including: Cattail (*Typha spp.*), Common Reed (*Phragmites australis*), Annual Blue Grass (*Poa compressa*), Kentucky Blue Grass, (*Poa pratensis*), Purple Loosestrife (*Lythrum salicaria*), Sandbar Willow (*Salix interior*), Barnyard Grass (*Echinochloa crusgalli*), Common buckthorn (*Rhamnus cathartica*), Glossy Buckthorn (*Rhamnus frangula*), Honeysuckle (*Lonicera spp.*) or Reed Canary Grass (*Phalaris arundinacea*).

- By the end of the third full year after planting no area over the entire vegetated restoration area greater than 0.5 square meters should be devoid of vegetation.

- If the restoration monitoring standards presented above are not achieved in reaches of the Site within three years of the completion of restoration in a particular reach, appropriate corrective restoration measures and monitoring will continue until the restoration standards are achieved in that reach of the Site.

- If the restoration monitoring standards presented above are achieved in reaches of the Site within three years of the completion of restoration in a particular reach, the restoration will be deemed successful and no further maintenance or monitoring will be required.

A stream habitat survey will be conducted prior to remedial activities to identify and quantify aquatic habitat structures to be restored or created. Once these structures have been constructed and have experienced bankfull flow conditions, monitoring efforts will focus on the stability of the structure. Stability will be evaluated by visual observation and comparison to design drawings, considering location in the stream, physical dimensions, and designed hydraulics. Monitoring of restored in-stream structure and habitat complexes will be performed annually during low-flow conditions (unless other flows are required to evaluate designed hydraulics for the structure) for a minimum of 3 years. If at the end of the three-year monitoring period, a bankfull event has not occurred, monitoring of erosion prone banks will continue until a bankfull flow event has occurred. If it is determined that aquatic structures have been compromised to the extent that they are not functioning as intended, then maintenance activities will be implemented for the deficient areas and monitoring of the deficient areas will be extended until the restoration/mitigation is deemed successful.

8. Summary and Conclusions

This Plan has presented the conceptual designs for the restoration of a variety of aquatic and terrestrial habitats that will be disturbed by remedial activities along the Creek and the River. Land types that will be disturbed consist of residential/commercial property (including the park district and city-owned properties), regulated wetlands, and DuPage County Forest Preserve Property. Restoration designs have been presented that apply to the variety of physical, biological, and cultural conditions that exist throughout the Site. This Plan has defined bank restoration techniques that will be applied to the various land types surrounding the Creek and the River. In addition, this Plan provides for vegetation restoration of emergent, scrub-shrub, and forested wetlands throughout the Sites; and has presented designs for the restoration of native upland forest communities on Forest Preserve property.

Additionally, to offset impacts in the Forest Preserve, this Plan has identified potential enhancement alternatives that will be incorporated into the detailed design document. Four different activities were presented that focus on improving the habitat quality of the River for fish, stabilizing currently eroding banks, improving the functionality of degraded riparian wetlands, and restoring degraded forest communities to historic natural conditions.

At this conceptual design phase, precise locations for the application of the various restoration options cannot be determined. However, based on existing information, Figures 2 through 6 provide examples at a broad scale of the types of environmental conditions that would influence the application of the different restoration options. These figures, bank restoration cross sections, and planting plans demonstrate the concepts behind the restoration designs and their applications. Under the detailed design phase, flow modeling and additional environmental data collection (e.g., stream morphology, wetland classification, etc.) will be performed to support the creation of detailed restoration design drawings that will refine the locations for the application of each restoration alternative.

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Tables

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Table 1

Conceptual Mitigation and Restoration Design Plan
Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
Kerr-McGee Chemical LLC, DuPage County, Illinois

<u>Summary of Land Use Disturbances</u>

Land Use	**Wetlands (acres)**			**Uplands (acres)**	**Total**
	Emergent	**Scrub-Shrub**	**Forested**		
Commercial/Residential	2.98	0.06	4.56	14.20	21.80
Forest Preserve	0.05	0.13	4.98	10.60	15.76
Total	12.76			24.80	37.56

<u>Note</u>:

1. Acreages are based solely on the Conceptual Design and will be revised in preliminary and final design.
2. Commercial/Residential land use includes park district and city-owned property.

Table 2

Conceptual Mitigation and Restoration Design Plan
Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
Kerr-McGee Chemical LLC, DuPage County, Illinois

<u>Open Floodplain Seed Mix</u>

Rate/Acre	Species	Common Name
2.70 lbs.	*Andropogon gerardii*	Big Bluestem
2.75 lbs.	*Andropogon scoparius*	Little Bluestem
0.16 lbs.	*Aster novae-angliae*	New England Aster
0.15 lbs.	*Bidens cernua*	Beggar Ticks
2.7 lbs.	*Calamagrostis canadensis*	Blue Joint Grass
0.14 lbs.	*Carex vulpinoidea*	Fox Sedge
1.3 lbs.	*Echinacea pallida*	Pale Purple Coneflower
2.70 lbs.	*Elymus canadensis*	Wild Rye
0.28 lbs.	*Eupatorium maculatum*	Spotted Joe Pye Weed
0.28 lbs.	*Eupatorium perfoliatum*	Boneset
3.20 lbs.	*Glyceria striata*	Fowl Manna Grass
1.60 lbs.	*Panicum virgatum*	Switchgrass
0.17 lbs.	*Pycanthemum virginianum*	Mountain Mint
1.05 lbs.	*Rudbeckia hirta*	Black-Eyed Susan
0.28 lbs.	*Silphium laciniatum*	Compass Plant
0.28 lbs.	*Silphium terebinthinaceum*	Prairie Dock
0.25 lbs.	*Solidago rigida*	Rigid Goldenrod
Cover crop:	Annual Rye @ 3 lbs. per acre	

<u>Note:</u>

1. Seed applied at rate of 20 lbs. per acre plus cover crop.
2. The above list of plant species have been selected to provide an appropriate seed mix for a number of potential environments in a broad spectrum approach. It is not anticipated that all species would be appropriate for all micro-habitats.

Table 3

Conceptual Mitigation and Restoration Design Plan
Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
Kerr-McGee Chemical LLC, DuPage County, Illinois

Shady Floodplain Seed Mix

Lbs./Acre	Species	Common Name
0.62	*Actinomeris alternifolia*	Wingstem
0.62	*Aquilegia canadensis*	Wild Columbine
0.62	*Aster lateriflorus*	Calico Aster
0.15	*Aster shortii*	Short's Aster
0.125	*Boehmeria cylindrica*	False Nettle
0.25	*Bromus latiglumis*	Vibrant Shade Grass
0.06	*Campanula americana*	Tall Bellflower
0.062	*Carex blanda*	Creek Sedge
0.5	*Cinna arundianacea*	Stout Woodreed
0.031	*Diarrhena americana*	Diarrhena
1.0	*Elymus riparius*	River Bank Wild Rye
0.768	*Elymus villosus*	Slender Wild Rye
2.0	*Elymus virginicus*	Virginia Wild Rye
0.15	*Eupatorium rugosum*	White Snakeroot
0.15	*Festuca obtuse*	Fescue
0.5	*Glyceria striata*	Fowl Manna Grass
0.25	*Impatiens capensis*	Spotted Jewel-Weed
0.25	*Leersiaoryzoides*	Rice Cutgrass
0.15	*Penstemon digitalis*	Foxglove Beard Tongue
0.15	*Phlox divaricata*	Wood Phlox
0.15	*Pilea pumila*	Clearweed
0.15	*Polygonatum canaliculatum*	Solomon's Seal
0.15	*Pycnanthemum virginianum*	Mountain Mint
0.44	*Rudbeckia laciniata*	Tall Coneflower
0.031	*Solidago flexicaulis*	Broadleaf Goldenrod
0.031	*Solidago gigantean*	Giant Goldenrod
0.125	*Solidago ulmifolia*	Elm-leaved Goldenrod
0.31	*Veronicastrum virginicum*	Culver's Root
0.062	*Zizia aurea*	Golden Alexanders
Cover Crop:	Annual Rye @ 4 lbs. Per acre	

Note:

1. Seed applied at rate of 10 lbs. per acre plus cover crop.
2. The above list of plant species have been selected to provide an appropriate seed mix for a number of potential environments in a broad spectrum approach. It is not anticipated that all species would be appropriate for all micro-habitats.

Table 4

Conceptual Mitigation and Restoration Design Plan
Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
Kerr-McGee Chemical LLC, DuPage County, Illinois

Shoreline Woody Plants

% Mix	Species	Common Name
20	*Cornus obliqua*	Silky Dogwood
30	*Cornum stolonifera*	Red Osier Dogwood
30	*Salix discolor*	Pussy Willow
10	*Spiraea alba*	Meadowsweet
10	*Ribes americanum*	Wild Black Currant

Notes:

1. Woody plant stock consists of shrub cuttings, whips, or bare root plants.

2. Shrubs will be planted at a density of 225 shrubs per acre in clusters of the same species.

Table 5

Conceptual Mitigation and Restoration Design Plan
Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
Kerr-McGee Chemical LLC, DuPage County, Illinois

<u>Upland Trees</u>

Species	Common Name
Carya cordiformis	Bitternut Hickory
Carya ovata	Shagbark Hickory
Fraxinus Americana	White Ash
Juglans nigra	Black Walnut
Ostrya virginiana	American Hophornbeam
Quercus alba	White Oak
Quercus macrocarpa	Bur Oak
Tilia Americana	American Basswood
Ulmus rubra	Red Elm

<u>Notes:</u>

1. Tree stock for upland restoration is 1.5-inch caliper root-bagged trees (2-inch equivalent).
2. Tree stock for upland bank restoration is 1-gallon container shrub.
3. Trees will be planted at a density of 100 trees per acre in clusters of same species.

Table 6

Conceptual Mitigation and Restoration Design Plan
Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
Kerr-McGee Chemical LLC, DuPage County, Illinois

Floodplain Trees

Species	Common Name
Betula nigra	River Birch
Celtis occidentalis	Hackberry
Cornus alternifolia	Alternate Leaf Dogwood
Crataegus crus-galli	Cockspur Hawthorn
Crataegus mollis	Down Hawthorn
Fraxinus Americana	White Ash
Platanus occidentalis	Sycamore
Quercus bicolor	Swamp White Oak
Quercus macrocarpa	Bur Oak
Salix amygdaloides	Peachleaf Willow

Notes:

1. Tree stock for floodplains is 1.5-inch caliper root-bagged trees (2-inch equivalent).
2. Tree stock for floodplain banks is 1-gallon container shrubs.
3. Trees will be planted at a density of 100 trees per acre in clusters of same species.

Table 7

Conceptual Mitigation and Restoration Design Plan
Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
Kerr-McGee Chemical LLC, DuPage County, Illinois

<u>Shoreline & Aquatic Plantings</u>

Rate/Acre	Species	Common Name
290	*Alisma plantago aquatica*	Great Water Plantain
390	*Carex lacustris*	Sedge
390	*Carex bebbii*	Bebb's Sedge
390	*Carex pellita*	Woolly Sedge
300	*Iris virginica shrevei*	Northern Blue Flag
390	*Juncus balticus*	Baltic Rush
390	*Juncus effusus*	Common Rush
200	*Nuphar advena*	Spatterdock
500	*Nymphaea tuberosa*	White Water Lily
290	*Pontaderia cordata*	Purple Pickerelweed
500	*Potamogeton nodosus*	Long-Leaved Pondweed
500	*Ranunculus flabellaris*	Yellow Water Buttercup
390	*Sagittaria latifolia*	Arrowhead
455	*Scirpus acutus*	Hardstem Bulrush
455	*Scirpus pungens*	Three-square Bulrush
455	*Scirpus atrovirens*	Dark Green Bulrush
365	*Scirpus fluviatilis*	River Bulrush
355	*Scirpus pendulus*	Bulrush
455	*Scirpus validus*	Soft-stem Bulrush
300	*Sparganium eurycarpum*	Giant Bur – Reed

<u>Notes:</u>

1. Plant stock consists of bare root plants.
2. Plants are planted in groups of same species.
3. Plant density is 3,900 plants per acre.

Table 8

Conceptual Mitigation and Restoration Design Plan
Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
Kerr-McGee Chemical LLC, DuPage County, Illinois

Floodplain Shrubs

Species	Common Name
Alnus rugosa	Speckled Alder
Aronia prunifolia	Purple Chokeberry
Cephalanthus occidentalis	Buttonbush
Cornus obliqua	Pale Dogwood
Cornus stolonifera	Red Osier Dogwood
Ribes americanum	Wild Black Currant
Viburnum lentago	Nannyberry

Notes:

1. Plant stock consists of bare roots, cuttings, whips, or container stock.
2. Shrubs will be planted at a density of 225 shrubs per acre in clusters of the same species.

Table 9

Conceptual Mitigation and Restoration Design Plan
Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
Kerr-McGee Chemical LLC, DuPage County, Illinois

<u>Open Upland Seeding</u>

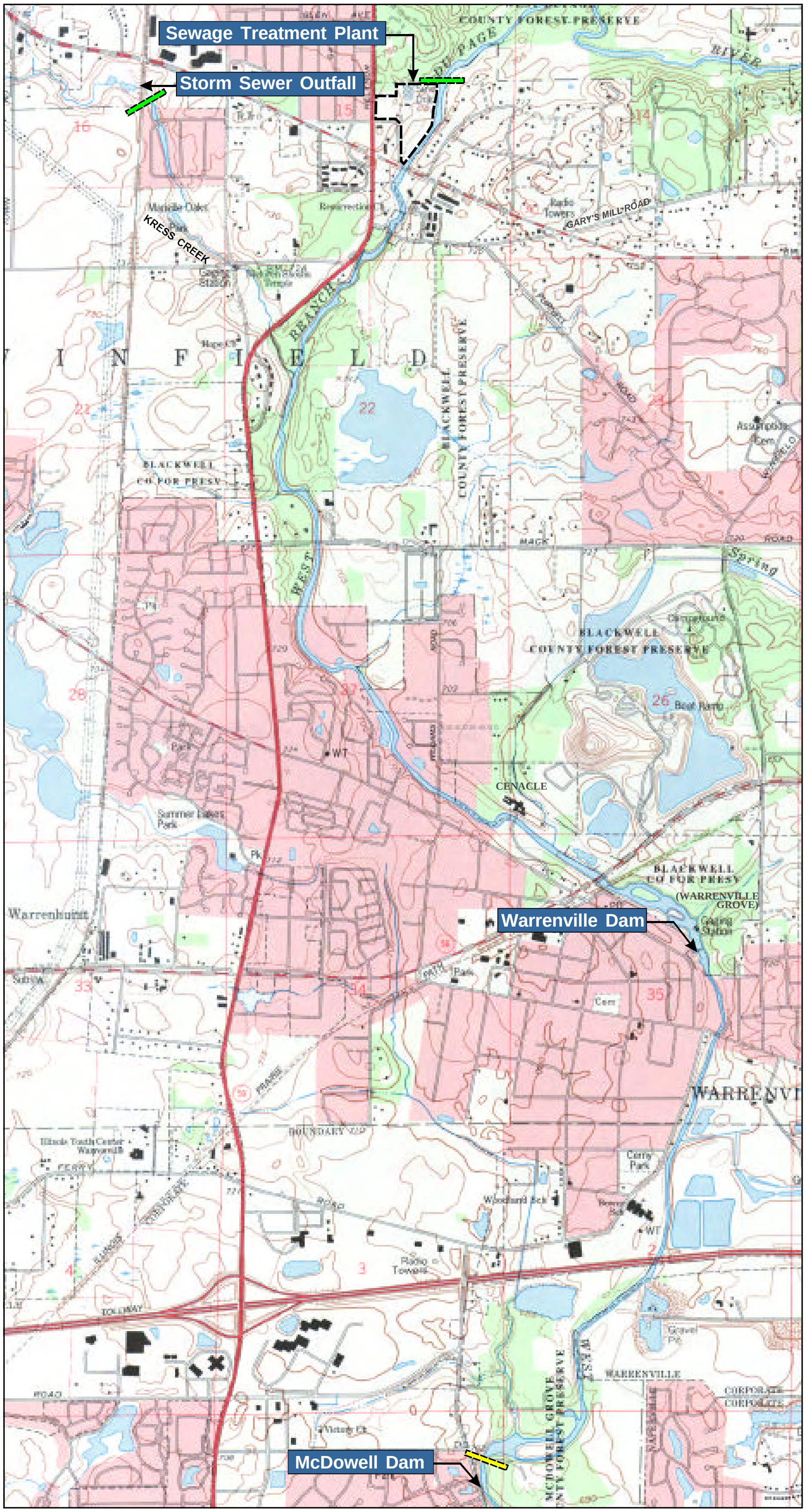
Rate/Acre	Species	Common Name
2.7 lbs.	*Adropogon gerardii*	Big Bluestem
2.7 lbs.	*Adropogon scoparius*	Little Bluestem
0.15 lbs.	*Allium cernuum*	Nodding Wild Onion
0.05 lbs.	*Amorpha canescens*	Leadplant
0.05 lbs.	*Asclepias verticillata*	Whorled Milkweed
0.25 lbs.	*Aster laevis*	Smooth Blue Aster
0.15 lbs.	*Aster nova-angliae*	New England Aster
0.05 lbs.	*Coreopsis palmata*	Prairie Coreopsis
0.10 lbs.	*Echinacea purpurea*	Purple Coneflower
0.25 lbs.	*Eryngium yuccifolium*	Rattlesnake Master
0.25 lbs.	*Liatris aspera*	Rough Blazing Star
0.15 lbs.	*Penstemon digitalis*	Foxglove Beard Tongue
0.50 lbs.	*Petalostemum purpureum*	Purple Prairie Clover
0.50 lbs.	*Ratibida pinnata*	Yellow Coneflower
0.50 lbs.	*Rudbeckia hirta*	Black-Eyed Susan
0.10 lbs.	*Solidago juncea*	Early Goldenrod
0.30 lbs.	*Solidago nemoralis*	Old Field Goldenrod
2.6 lbs.	*Sorghastrum nutans*	Indian Grass
0.15 lbs.	*Tradescantia ohiensis*	Spiderwort
0.25 lbs.	*Verbena stricta*	Hoary Vervain
0.25 lbs.	*Zizia aptera*	Heart Leaved Meadow Parsnip
Cover crop:		Annual Rye @ 3 lbs. per acre

<u>Note:</u>

Seed applied at rate of 12 lbs. per acre plus cover crop.

Figures

Figures



REFERENCE: BASE MAP USGS 7.5 MIN. QUAD., NAPERVILLE, ILL., 1993.

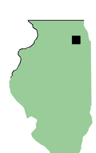
2000' 0 2000'

Approximate Scale: 1" = 2000'

LEGEND:

= Indicates Upstream Limit

= Indicates Downstream Limit



Area Location

KERR-MCGEE CHEMICAL LLC
KRESS CREEK/WEST BRANCH DUPAGE RIVER AND
SEWAGE TREATMENT PLANT SITES

CONCEPTUAL MITIGATION AND RESTORATION DESIGN PLAN

SITE LOCATION MAP

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FIGURE
1

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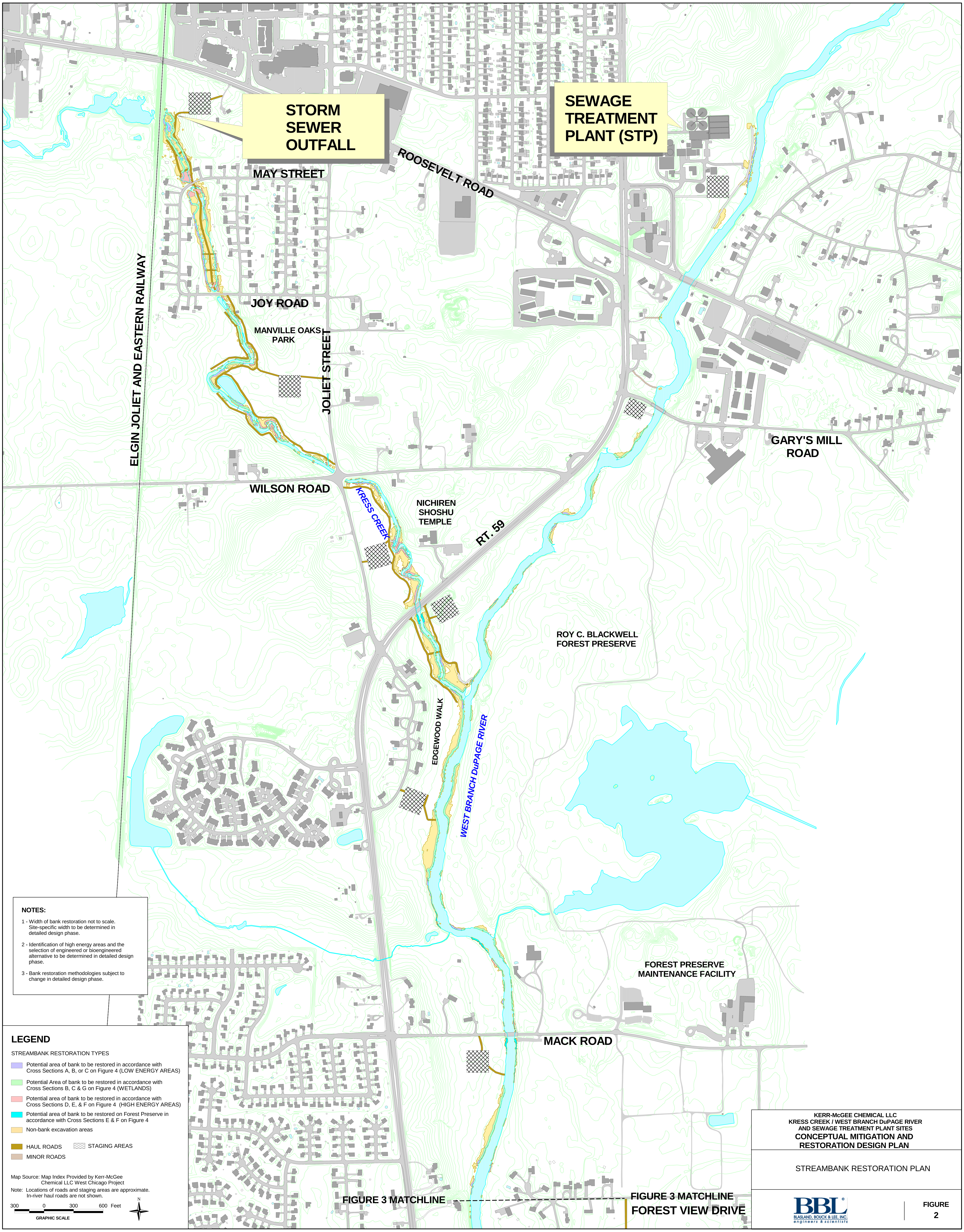

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NOTES:

1 - Width of bank restoration not to scale. Site-specific width to be determined in detailed design phase.

2 - Identification of high energy areas and the selection of engineered or bioengineered alternative to be determined in detailed design phase.

3 - Bank restoration methodologies subject to change in detailed design phase.

LEGEND

STREAMBANK RESTORATION TYPES

- Potential area of bank to be restored in accordance with Cross Sections A, B, or C on Figure 4 (LOW ENERGY AREAS)
- Potential Area of bank to be restored in accordance with Cross Sections B, C & G on Figure 4 (WETLANDS)
- Potential area of bank to be restored in accordance with Cross Sections D, E, & F on Figure 4 (HIGH ENERGY AREAS)
- Potential area of bank to be restored on Forest Preserve in accordance with Cross Sections E & F on Figure 4
- Non-bank excavation areas

- HAUL ROADS
- STAGING AREAS
- MINOR ROADS

Map Source: Map Index Provided by Kerr-McGee Chemical LLC West Chicago Project

Note: Locations of roads and staging areas are approximate. In-river haul roads are not shown.

300 0 300 600 Feet

GRAPHIC SCALE

N

KERR-McGEE CHEMICAL LLC
KRESS CREEK / WEST BRANCH DuPAGE RIVER AND SEWER TREATMENT PLANT SITES

CONCEPTUAL MITIGATION AND RESTORATION DESIGN PLAN

STREAMBANK RESTORATION PLAN

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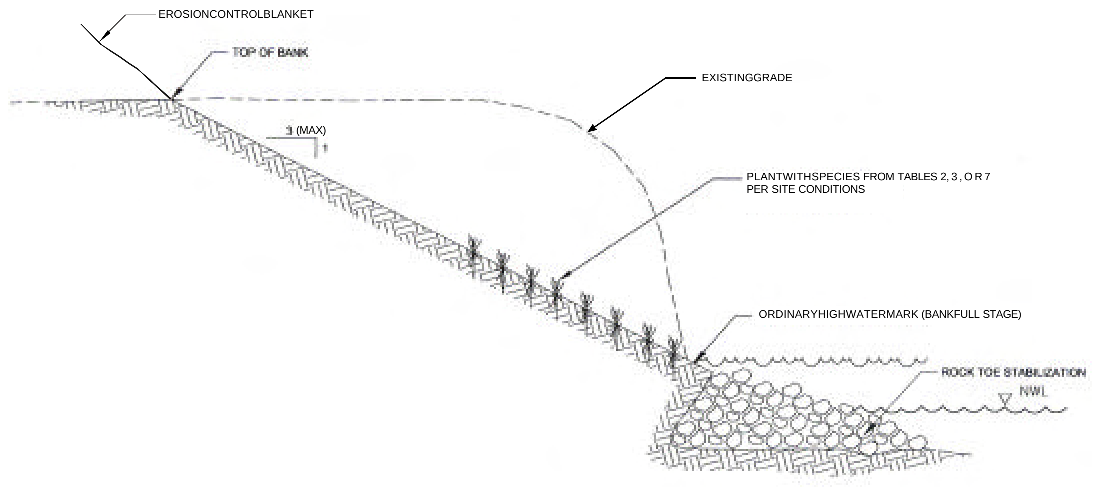
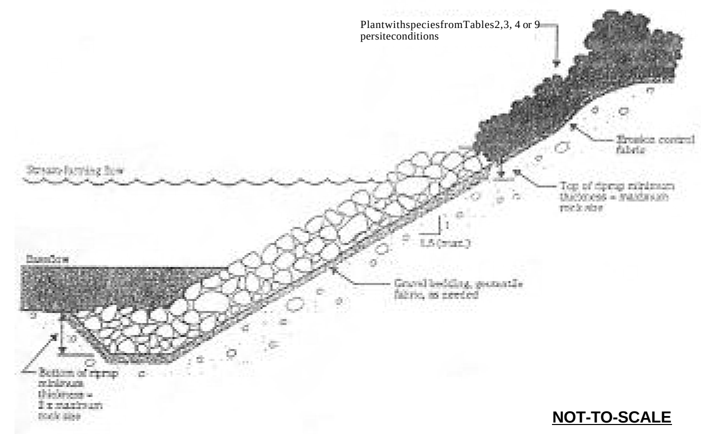
FIGURE 3



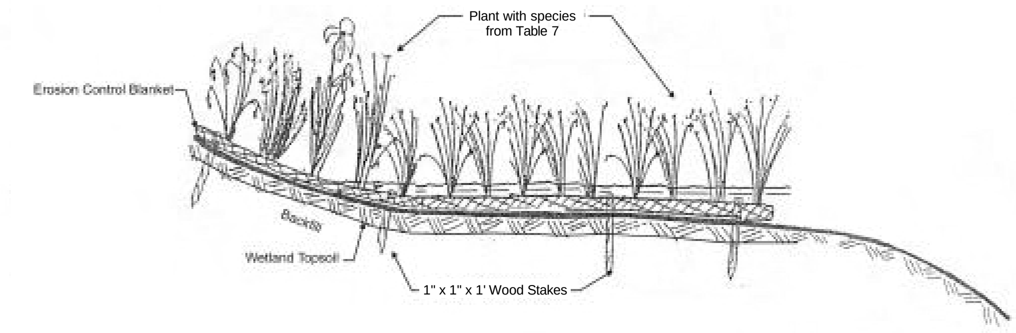
NOT-TO-SCALE

CROSS SECTION A - TYPICAL LOW VELOCITY VEGETATED BANK RESTORATION



NOT-TO-SCALE

CROSS SECTION D - POTENTIAL HIGH VELOCITY ENGINEERED BANK RESTORATION FOR PRIVATE PROPERTY



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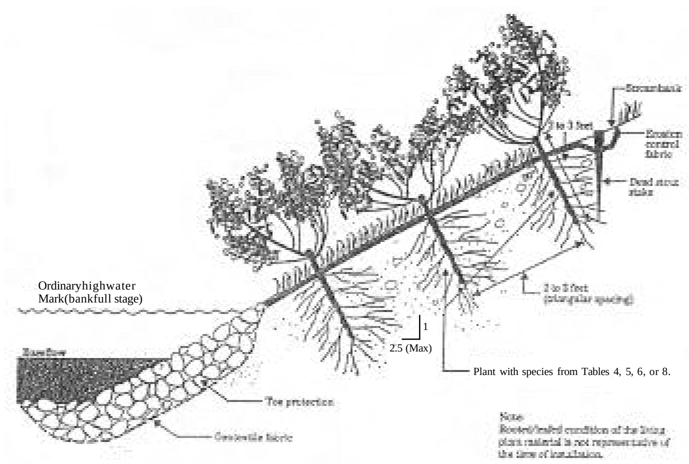
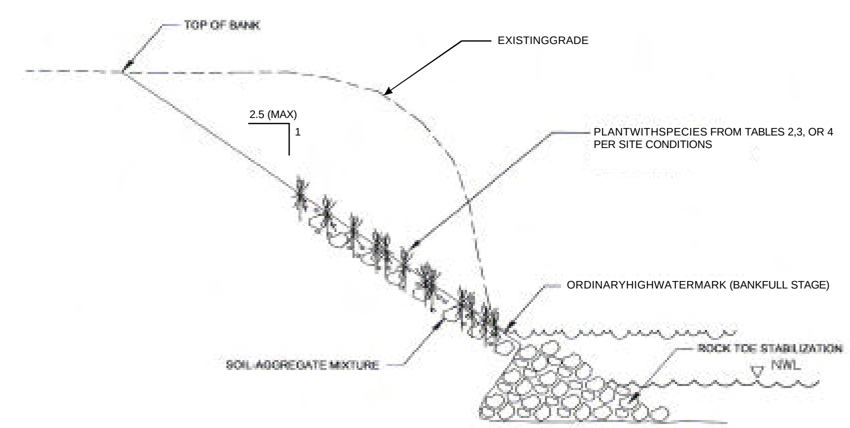
CROSS SECTION G - TYPICAL WETLAND BANK RESTORATION



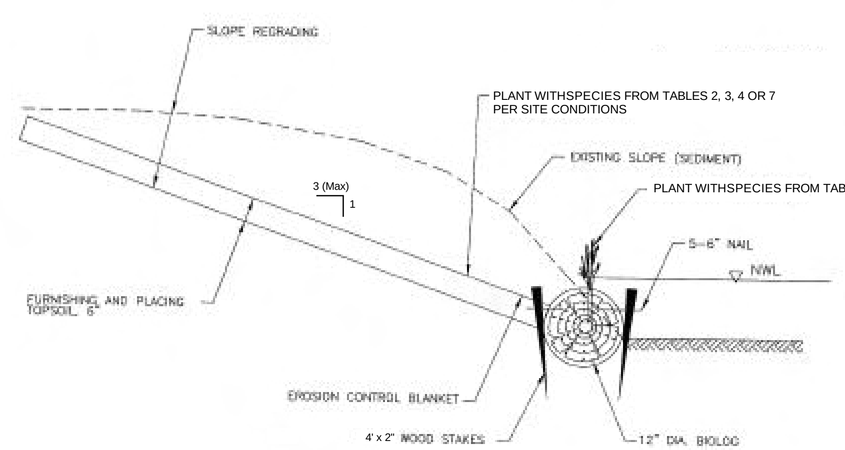
NOT-TO-SCALE

CROSS SECTION B - TYPICAL LOW VELOCITY SHRUB-VEGETATED BANK RESTORATION



NOT-TO-SCALE

CROSS SECTION E - TYPICAL HIGH VELOCITY BIOENGINEERED BANK RESTORATION (SOIL-AGGREGATE REINFORCEMENT)



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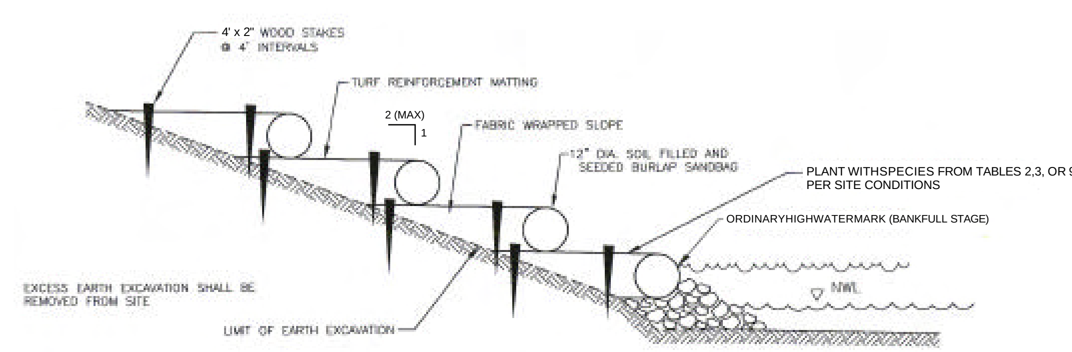
CROSS SECTION C - TYPICAL LOW VELOCITY BIOENGINEERED BANK RESTORATION (COIR LOGS)



NOT-TO-SCALE

CROSS SECTION F - TYPICAL HIGH VELOCITY BIOENGINEERED BANK RESTORATION (FABRIC WRAPPED SLOPE)

KERR-MCGEE CHEMICAL LLC
KRESS CREEK/WEST BRANCH DUPAGE RIVER AND SEWAGE TREATMENT PLANT SITES

CONCEPTUAL MITIGATION AND RESTORATION DESIGN PLAN

TYPICAL STREAMBANK RESTORATION CROSS SECTIONS

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FIGURE
4

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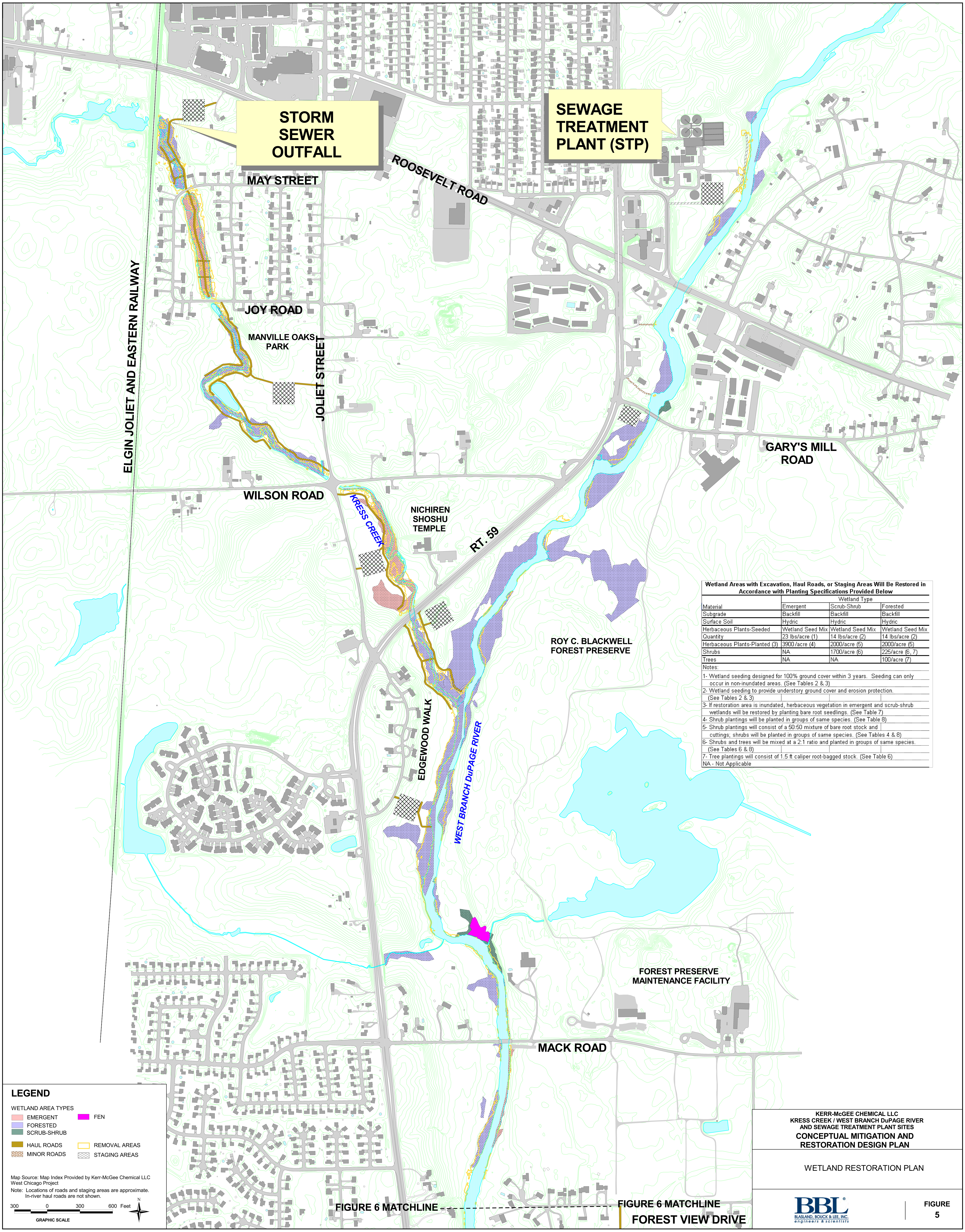

Wetland Areas with Excavation, Haul Roads, or Staging Areas Will Be Restored in Accordance with Planting Specifications Provided Below

	Wetland Type		
Material	Emergent	Scrub-Shrub	Forested
Subgrade	Backfill	Backfill	Backfill
Surface Soil	Hydric	Hydric	Hydric
Herbaceous Plants-Seeded	Wetland Seed Mix	Wetland Seed Mix	Wetland Seed Mix
Quantity	23 lbs/acre (1)	14 lbs/acre (2)	14 lbs/acre (2)
Herbaceous Plants-Planted (3)	3900/acre (4)	2000/acre (5)	2000/acre (5)
Shrubs	NA	1700/acre (6)	225/acre (6, 7)
Trees	NA	NA	100/acre (7)

Notes:

1- Wetland seeding designed for 100% ground cover within 3 years. Seeding can only occur in non-inundated areas. (See Tables 2 & 3)

2- Wetland seeding to provide understory ground cover and erosion protection. (See Tables 2 & 3)

3- If restoration area is inundated, herbaceous vegetation in emergent and scrub-shrub wetlands will be restored by planting bare root seedlings. (See Table 7)

4- Shrub plantings will be planted in groups of same species. (See Table 8)

5- Shrub plantings will consist of a 50:50 mixture of bare root stock and cuttings; shrubs will be planted in groups of same species. (See Tables 4 & 8)

6- Shrubs and trees will be mixed at a 2:1 ratio and planted in groups of same species. (See Tables 6 & 8)

7- Tree plantings will consist of 1.5 ft caliper root-bagged stock. (See Table 6)

NA - Not Applicable

KERR-McGEE CHEMICAL LLC
KRESS CREEK / WEST BRANCH DuPAGE RIVER
AND SEWAGE TREATMENT PLANT SITES

CONCEPTUAL MITIGATION AND RESTORATION DESIGN PLAN

WETLAND RESTORATION PLAN

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FIGURE 5

9/28/04 SYR-85 TBR EAB
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Wetland Areas with Excavation, Haul Roads, or Staging Areas Will Be Restored in Accordance with Planting Specifications Provided Below

	Wetland Type		
Material	Emergent	Scrub-Shrub	Forested
Subgrade	Backfill	Backfill	Backfill
Surface Soil	Hydric	Hydric	Hydric
Herbaceous Plants-Seeded	Wetland Seed Mix	Wetland Seed Mix	Wetland Seed Mix
Quantity	23 lbs/acre (1)	14 lbs/acre (2)	14 lbs/acre (2)
Herbaceous Plants-Planted (3)	3900 /acre (4)	2000/acre (5)	2000/acre (5)
Shrubs	NA	1700/acre (6)	225/acre (6, 7)
Trees	NA	NA	100/acre (7)

Notes:

1- Wetland seeding designed for 100% ground cover within 3 years. Seeding can only occur in non-inundated areas. (See Tables 2 & 3)
2- Wetland seeding to provide understory ground cover and erosion protection. (See Tables 2 & 3)
3- If restoration area is inundated, herbaceous vegetation in emergent and scrub-shrub wetlands will be restored by planting bare root seedlings. (See Table 7)
4- Shrub plantings will be planted in groups of same species. (See Table 8)
5- Shrub plantings will consist of a 50:50 mixture of bare root stock and cuttings; shrubs will be planted in groups of same species. (See Tables 4 & 8)
6- Shrubs and trees will be mixed at a 2:1 ratio and planted in groups of same species. (See Tables 6 & 8)
7- Tree plantings will consist of 1.5 ft caliper root-bagged stock. (See Table 6)
NA - Not Applicable

NOTE:

1. WETLANDS IN THE McDOWELL GROVE FOREST PRESERVE WERE DIGITIZED FROM DuPAGE COUNTY WETLAND INVENTORY MAP, DEPARTMENT OF ENVIRONMENTAL CONCERNS, WHEATON, ILLINOIS 1994. WETLANDS BETWEEN WARRENVILLE DAM AND McDOWELL GROVE ARE NOT SHOWN ON THIS FIGURE.

LEGEND

WETLAND AREA TYPES
- EMERGENT
- FORESTED
- SCRUB-SHRUB

- HAUL ROADS
- MINOR ROADS
- REMOVAL AREAS
- STAGING AREAS

Map Source: Map Index Provided by Kerr-McGee Chemical LLC
West Chicago Project

Note: Locations of roads and staging areas are approximate. In-river haul roads are not shown.

KERR-McGEE CHEMICAL LLC
KRESS CREEK / WEST BRANCH DuPAGE RIVER
AND SEWAGE TRREATMENT PLANT SITES

CONCEPTUAL MITIGATION AND RESTORATION DESIGN PLAN

WETLAND RESTORATION PLAN

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FIGURE 6

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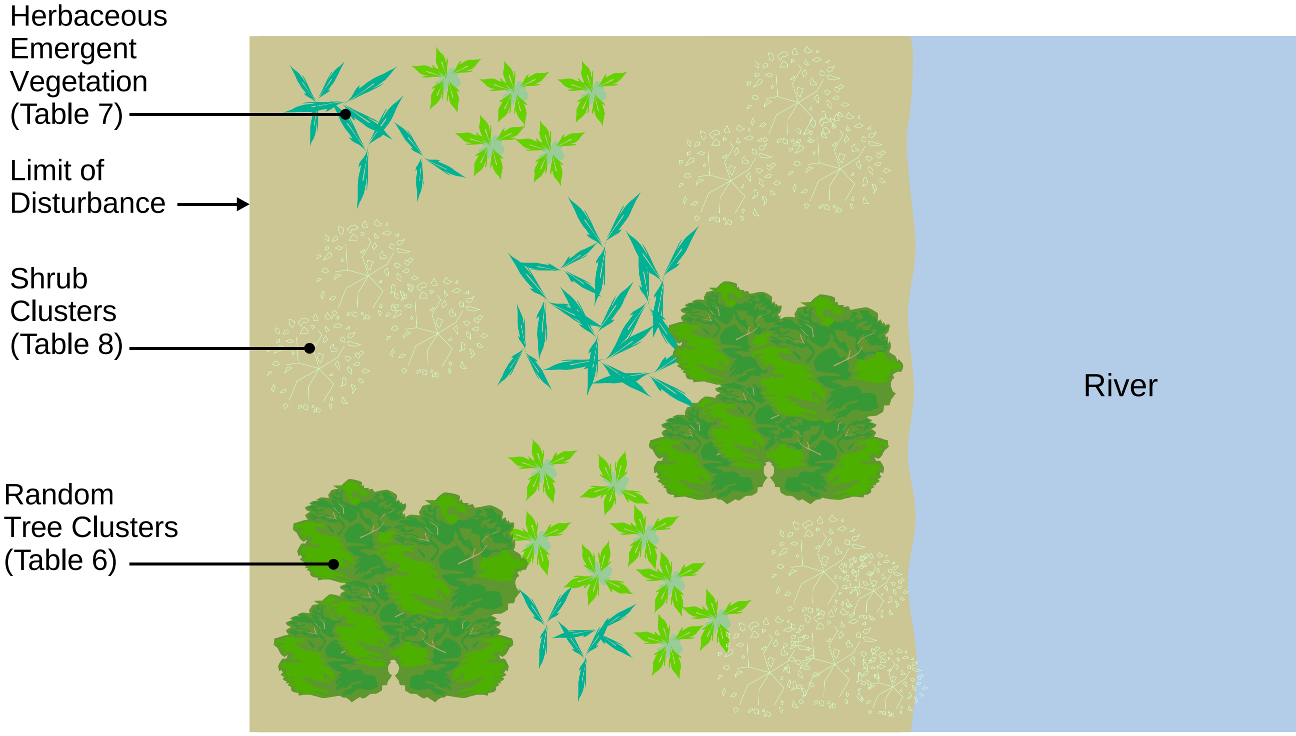
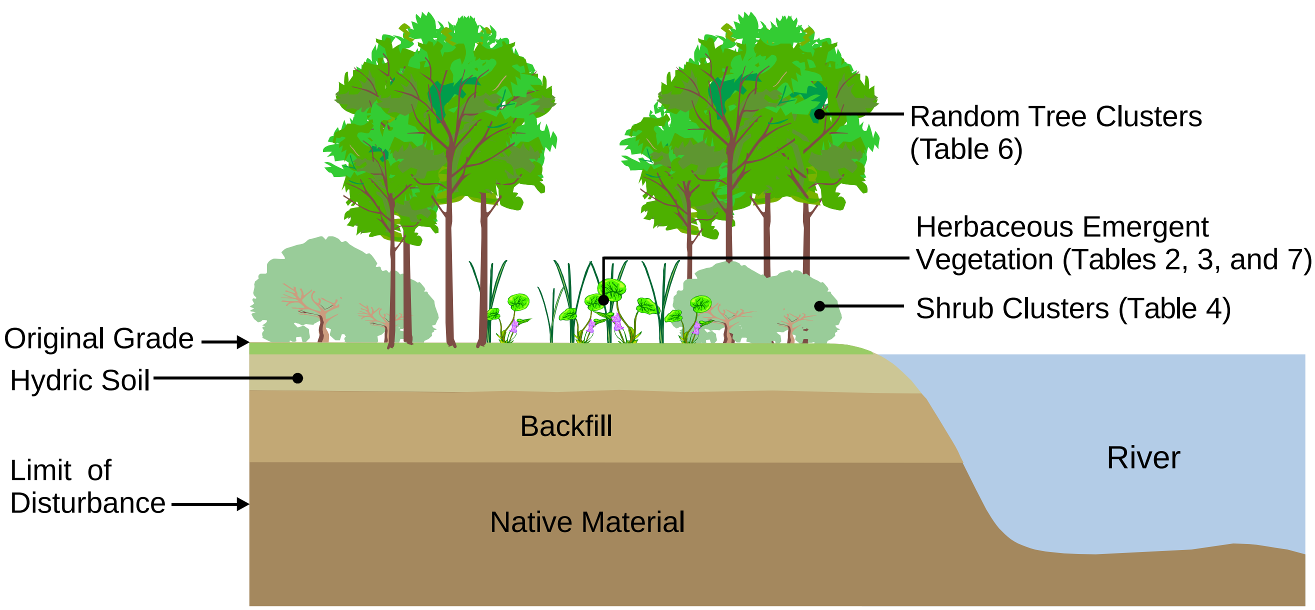


TYPICAL PLAN VIEW



NOT-TO-SCALE

TYPICAL CROSS-SECTION

KERR-MCGEE CHEMICAL LLC
KRESS CREEK/WEST BRANCH DUPAGE RIVER AND SEWAGE TREATMENT PLANT SITES

CONCEPTUAL MITIGATION AND RESTORATION DESIGN PLAN

RESTORATION OF FORESTED WETLANDS

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FIGURE 9

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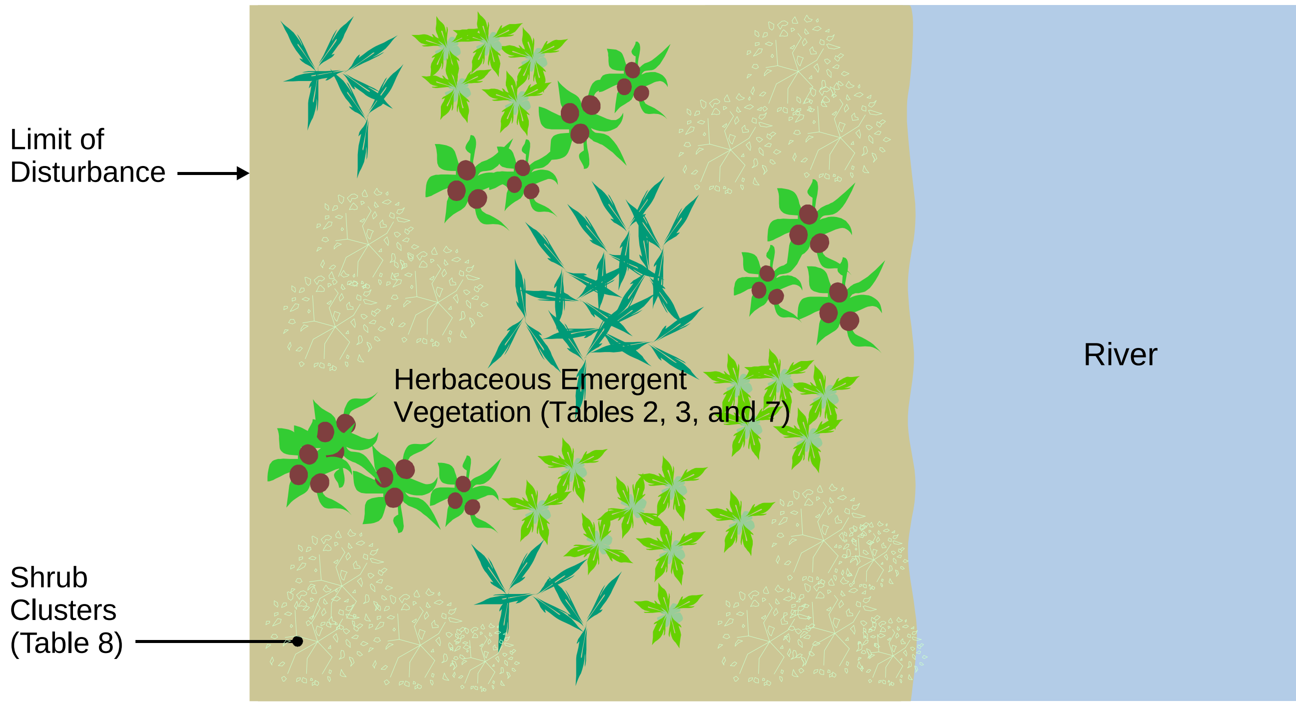
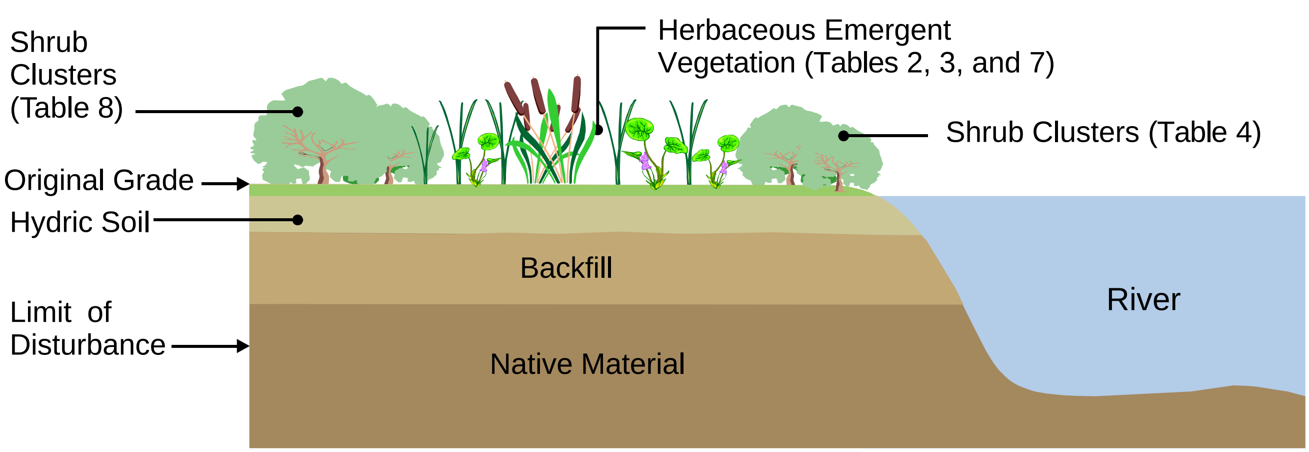


TYPICAL PLAN VIEW



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TYPICAL CROSS-SECTION

KERR-MCGEE CHEMICAL LLC
KRESS CREEK/WEST BRANCH DUPAGE RIVER AND
SEWAGE TREATMENT PLANT SITES

CONCEPTUAL MITIGATION AND RESTORATION DESIGN PLAN

RESTORATION OF SCRUB-SHRUB WETLANDS

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FIGURE
8

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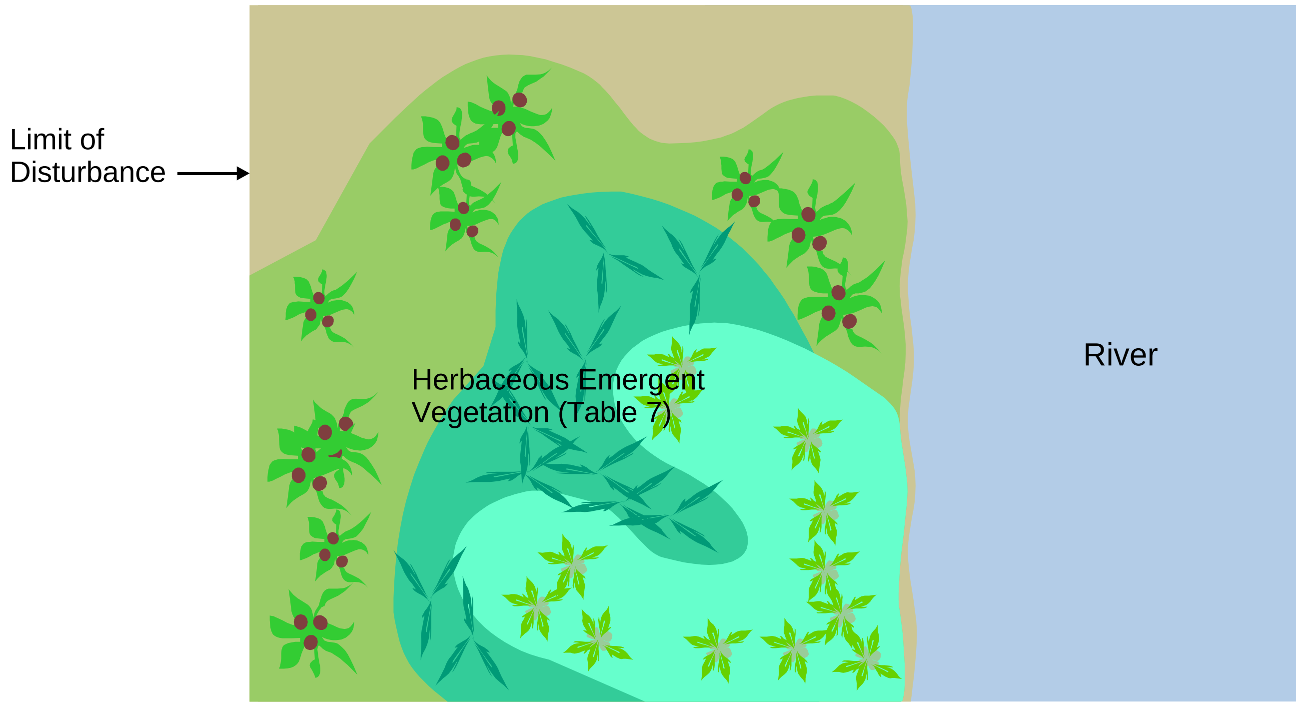
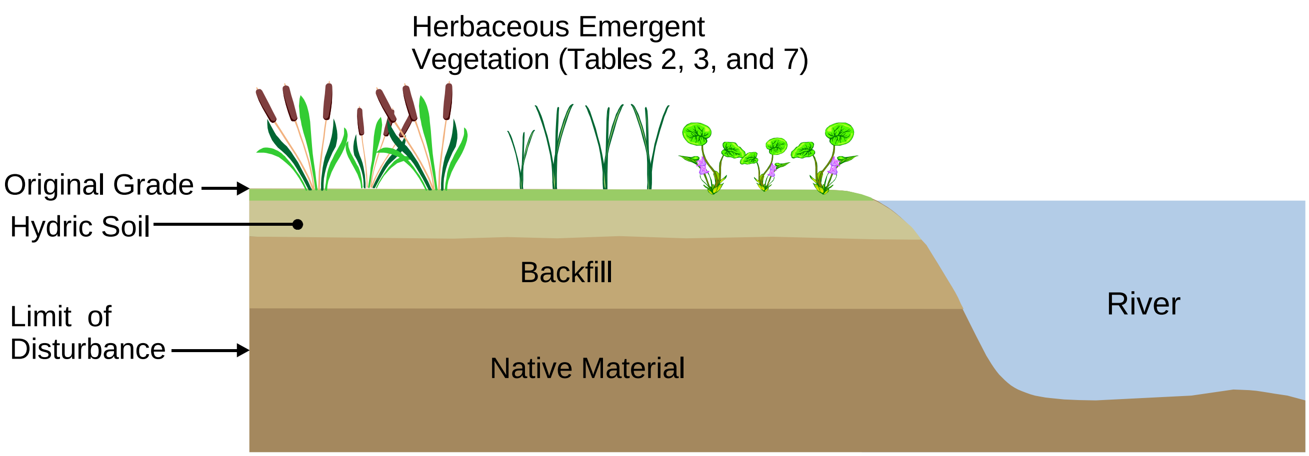


TYPICAL PLAN VIEW



NOT-TO-SCALE

TYPICAL CROSS-SECTION

KERR-MCGEE CHEMICAL LLC
KRESS CREEK/WEST BRANCH DUPAGE RIVER AND
SEWAGE TREATMENT PLANT SITES

CONCEPTUAL MITIGATION AND RESTORATION DESIGN PLAN

**RESTORATION OF
EMERGENT WETLANDS**

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**FIGURE
7**

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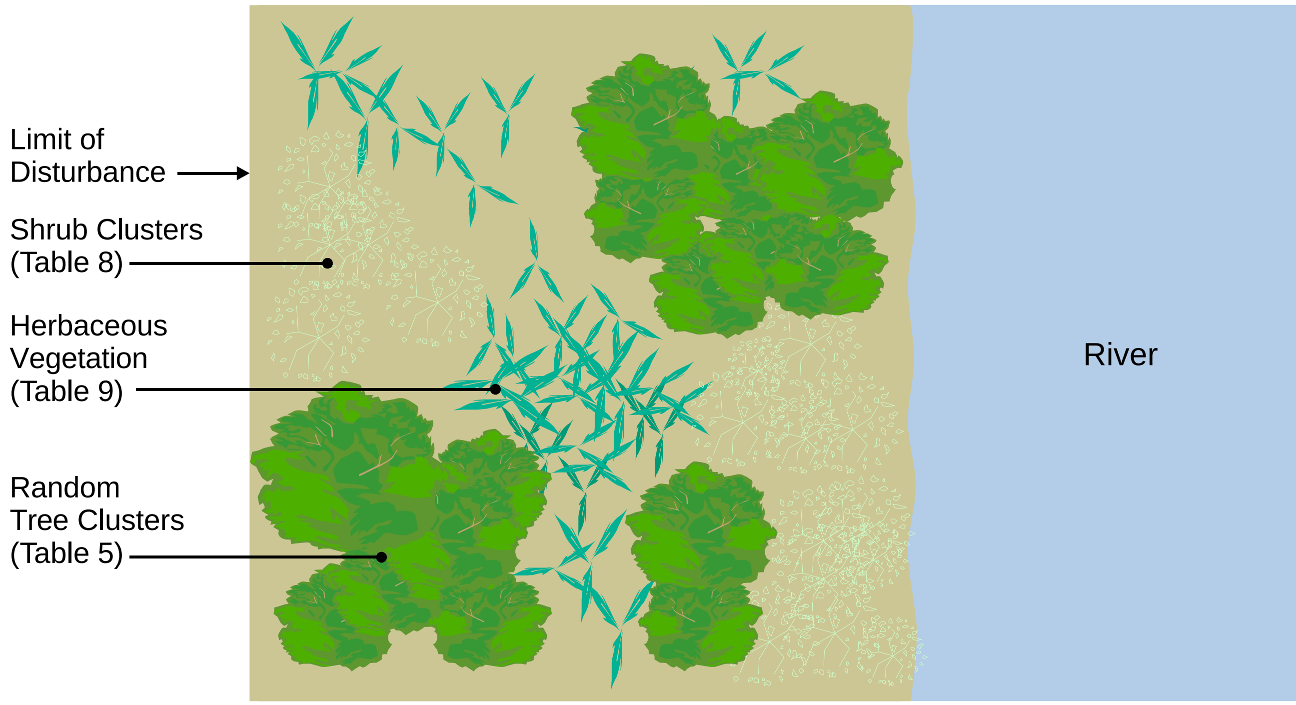
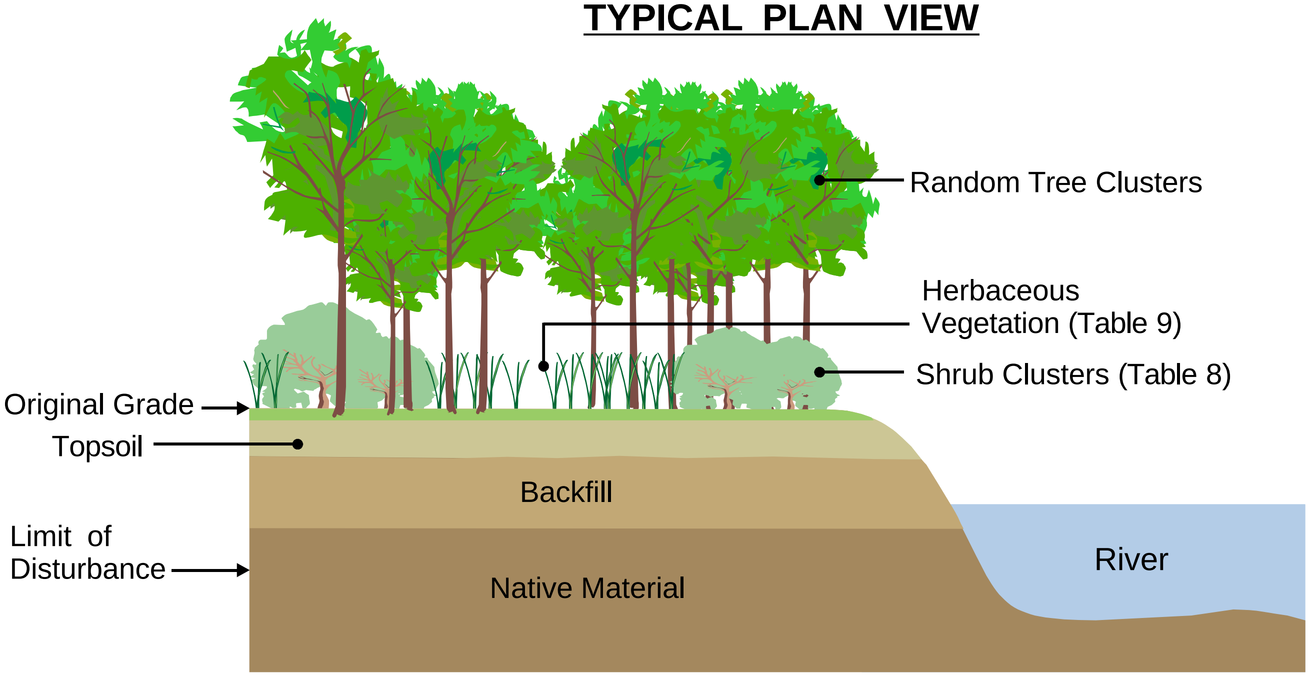


TYPICAL PLAN VIEW



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TYPICAL CROSS-SECTION

KERR-MCGEE CHEMICAL LLC
KRESS CREEK/WEST BRANCH DUPAGE RIVER AND SEWAGE TREATMENT PLANT SITES

CONCEPTUAL MITIGATION AND RESTORATION DESIGN PLAN

RESTORATION OF UPLAND FOREST

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FIGURE
10

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